IASDR07
INTERNATIONAL ASSOCIATION OF SOCIETIES OF DESIGN RESEARCH THE HONG KONG POLYTECHNIC UNIVERSITY 12TH TO 15TH NOVEMBER 2007

DESIGNING PERSONALIZED INTELLIGENT USER INTERFACES

Katharina Bredies', Gesche Joost' and Rosan Chow'

'Deutsche Telekom Laboratories, Berlin, Germany, katharina.bredies@telekom.de, gesche.joost@telekom.de, rosan.chow@telekom.de

ABSTRACT:

Nowadays, the complexity of information communication technology has become a serious obstacle for many users. Personalization of user interfaces could become a useful instrument to increase usability for the individual. Technical and market research on content personalization have already been conducted during the last years. Although personalized content works quite well for customers, research in personalizing interfaces remains relatively new.

The present paper describes an iterative design process on the development of an interface personalization prototype. We introduced a methodology to integrate user needs into the design process as well as in the resulting product, and recorded our experience with the applied methods. We also evaluated their appropriateness to the present research context.

This project reflects the advantages of design methods in interdisciplinary teams and how they could serve as a means to communicate ideas between stakeholders.

INTRODUCTION

As innovation in research and development becomes a competitive advantage, the ability of designers as innovation process leaders has been discovered during the last few years (Perks, Cooper and Jones 2005). Designers turn out to be excellent innovators due to their projective capabilities and integrative role between market researchers and engineers (Ravasi and Lojacono 2005). Unfortunately, the perception of design as an innovation driver is not necessarily common among all researchers in the high tech field. In this study, we describe the use of design methods and the role of designers in a technical-driven research context to support personalization of user interfaces.

Initially we were only involved to designining graphic user interfaces in the project, a domain that lies beyond the competences of computer scientists. We were a group of two professional interface designers and two graduate students and joined the team for the purpose of visual support. However, since our role was not clearly defined, we took the opportunity to introduce user-centered design methods to the technical centered research context. Our example should demonstrate how a designer's early involvement in a project could significantly improve the acceptance and usability of a service. This paper presents a detailed report on design methods from the field, documenting the design process on a problem that requires technical knowledge as well as design skills, namely personalizing user interfaces. The project's main focus was the implementation of the technical framework, a database to collect personal data from various applications and to complement the data set with classification algorithms (Korth and Plumbaum 2007) so that the same personal information can be applied in different contexts for different purposes. In our case, the personalization data should be used to improve the user interface.

We joined the project team from the beginning and have considerably influenced the development process. On one hand, we contributed narrative and visual methods to define the use cases in order to match our designs with the computer scientists and to provide materials for first user testing. On the other hand, we added a certain look and feel to the interface to ensure clarity and comprehensive structure. Both tasks served to make the service more appealing and the personalization process more transparent. Therefore the present case study does not only show a typical user centered design process (Deutsches Institut für Normung 1999) but also provides insight into the role of design in technical innovation.

At the beginning of the process, the whole team developed a service scenario. We listed the user requirements for the interface (Laurel 2003) that had to be fulfilled by the computer scientists. We then built and refined the interface in several iterations. Each iteration consisted of design sketches or design modifications, followed by technical implementation. The interfaces were evaluated through focus group interviews and we would then change the designs in the subsequent iteration with reference to the interview results. The outcome was a prototypical service interface that enables users to personalize their mobile phone.

THE DEVELOPMENT PROCESS

The following is an overview of all the steps in the development process:

1. service description;
2. scenario development;
3. card sorting;
4. setting user requirements and defining a functional framework;,
5. developing the interface designs and implementing the prototype;and
6. expert evaluation of the interface's usability.

Step 5 and 6 were repeated in order to refine the designs based on the evaluation results. The following sections will describe each step in detail.

At the beginning of the project, the market researchers conducted a study on user attitude towards personalization services. Users were classified into social milieus following Sinus Sociovision's milieu model (Sinus Sociovision GmbH 2007). This model reveals milieu-specific use of information technology and provides a clear overview of people's expectations, worries and needs.

Social user surveys could provide detailed statements from well-defined groups and present commonality as well as differences among users in a comparable way. For designers, social user surveys are excellent sources to get well-founded information about the users which designers could not have discovered in the same range and quality. Unlike observations, these surveys reveal the opinions and self-perception of users, but not their actions and the context they are in. In this project, the use of social surveys was adequate to define the scenario descriptions but of limited use for predicting the impact of our designs on the milieu groups.

In the past, user survey results stated that technical devices which offered usable handling and careful design (such as iPod) were perceived as positive but rare exceptions. This demonstrates how a careful interface design can turn a product with ordinary functions into a style icon. Since mobile phones have become a mass product, they have become multifunctional devices. Nowadays the in- and output of the device that is somewhat appropriate for phone calls can also be used for navigation in menu structures, browsing the internet, playing games or taking photos. However, inputting text or browsing the menu structure with the modest input possibilities can be troublesome.

SERVICE DESCRIPTION

The whole team used the customer survey results as original material for developing service ideas. Together, we decided to build an online configuration tool for mobile devices. Although mobile phones have become very personal devices, their usage varies greatly among different user groups. Visual changes of the device's cover are already common yet the personalization of functionalities is not. The customization of mobile phone functions could cover a wider range of needs, as the purpose and emphasis of the changes can be very different. Moreover, personalizing the functions of a mobile phone can simplify its operation and enhance usability.The example of mobile device complexity demonstrated a clear need for personalized interfaces. Most mobile phones contain an increasing amount of functions that are not always known or used. Although individuals may demand only certain functions, cell phone manufacturers do not usually reduce the functionality of their products because of this. As a result, users are faced with a broad choice of functions which they have not asked for and this makes handling more complex and less efficient.

In this project, we proposed a service to personalize the phone's features and appearance in which the customer could add new functions or remove the unused ones. S/he could also define his/her own menu structure, shortcuts and profiles, or select another theme for the menu. The personalization framework would detect frequency of use and content preferences. AI methods and fixed rules were used to complement additional information out of the provided data. Both the mobile phone interface and the configuration tool interface could be personalized, explicitly (by the user) and implicitly (by automation).In this case, an individual user should be able to choose and control his/her interface preferences while being supported by the personalization framework.

A COMMON PICTURE: DEVELOPING SCENARIOS AND PERSONAS

In this project, we have chosen three different user types for the scenario development: the elderly, business people and teenagers. According to an internally used mathematical model to compute demands (CET), these three groups were the first and most promising groups to address either because they are already keen on using new technologies with high-quality interfaces, or because they offer additional unaddressed market potential. All three groups would accept personalization under very different conditions while benefiting a lot from highly usable interfaces, be it for fun, efficiency, or inexperience.The following summarises the characteristics of each user group.

The elderly. Users in this group are mainly information technology novices, but active, well educated and interested.In terms of using mobile phones, they are expected to get impatient with complicated and difficult-to-learn interfaces. Senior users will estimate the practical values of their mobile phones but do not wish to spend much effort to operate the device. After getting used to one device, they may be easily annoyed if they have to change their habits in order to use a new one. Also, they probably prefer reducing their phone functions to only the core ones. The interests of the elderly seem to have been overlooked by existing mobile phone designs.
Probably, the elderly would be far more interested in mobile devices if they are offered comfortable and reasonable services.Nevertheless the usability requirements for this user group are especially strict as less experienced users may be easily distracted by exotic interface logics and keen on familiar ones (Ziefle and Bay 2004, Ziefle 2005).The proposed customized user interface could help to make a device more user-friendly by sorting out the unnecessary features.

Business people. Users in this group are mainly professionals who frequently use their mobile phones. They demand their phone to 'behave' differently depending on their actual whereabouts, be it the office, on business travels or in the evening. They are likely to appreciate intelligent automation, if it helps to save time and dismiss them from annoying administration tasks. These users may also have the need for precise, specific and fast information.

Teenagers. Users in this group use their mobile phones extensively to stay in touch with their friends. They are probably most interested in updating their devices regularly, because they want to keep up with the fast changing fashion trends. They are also more apt to new experimental interface designs, as they grow up with information technology. Since these users can afford most time in learning and handling their mobile phones, they know every function their devices offer.

Based on the features above, we then created a character and a story about the usage on the mobile phone configuration service for each group. Since the three personas have very different interests, the scenarios cover many possibilities of use.

Eva, a retired woman in her sixties, has learned to handle her phone quite well and uses it regularly. As her device shows some defects, she is thinking about buying a new one. However, she feels overwhelmed when the salesperson shows her a dozen new devices armed with fancy functions that she does not want. So the salesperson suggests buying the phone which allows personal configuration of the features. He shows her how to handle the configuration wizard located in the shop. After this short introduction, Eva is now able to select her favorite combination of features in addition to transferring her old menu and contacts to the new device (Illustration 1).

Clarissa is a very busy woman who has to travel a lot. She does not want to be bothered with unnecessary functions that she does not use. The configuration tool monitors her activities; if she does not use a certain feature, the tool will then propose to replace it with a more interesting one. Clarissa also appreciates the profile management function in the configuration tool. She can easily set up profiles for her device so she can always choose the right one for every situation (Illustration 2).

Alan, a teenage boy, is a very active mobile phone user who is always keeps up with the latest offers. He is playful and curious and he reconfigures his phone at home regularly via the online configuration service. Alan receives recommendations from the system for new offers, browses the feature library and takes a look at various new themes for his phone (Illustration 3).

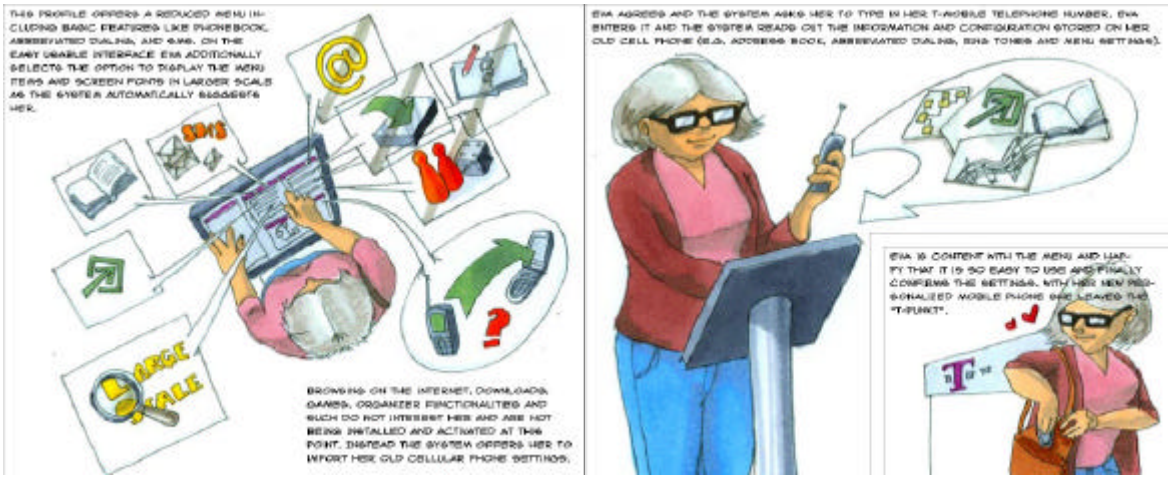

Illustration1: Example pages from the illustrated user scenario for the persona "Eva"

Illustration 2: Example pages from theillustrated user scenario for the persona “Clarissa”

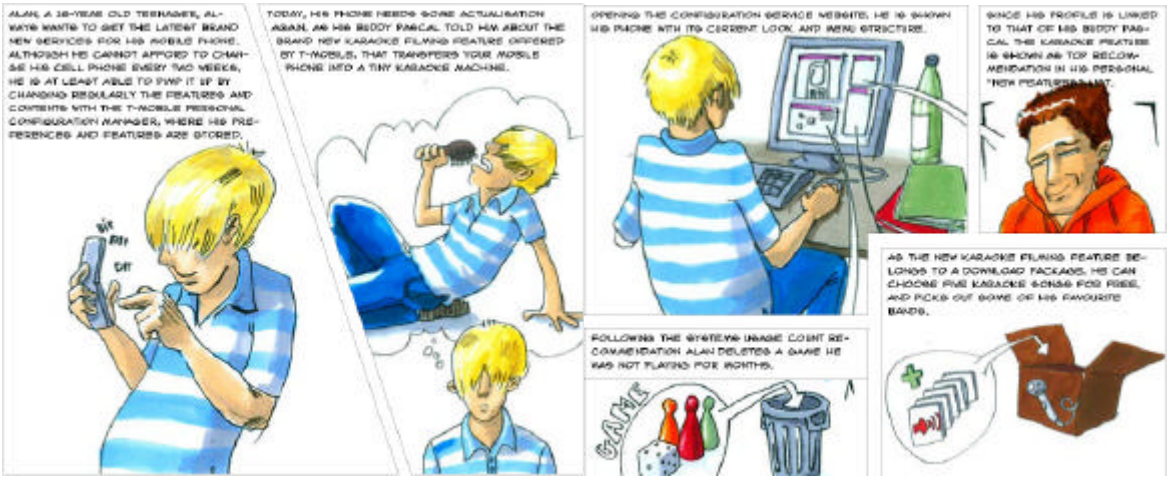

Illustration 3: Example pages from the illustrated user scenario for the persona from “Alan”

Applying personas and scenarios instead of real persons may cause designers to oversimplify the customers. In this project, since no one in the design could actually represent one of the user groups and correct our presumed image, we could only rely on the quality of the user survey and our own exemplary experience. This should not be a problem as long as the customers' interests and background are close to those of the designers. However, it would become increasingly difficult to portray a precise image when these groups’ interests and background drift apart.

For this reason, catering the elderly user group was especially challenging for us in this project. Since it was inevitable that the user persona developed was to some extent influenced by our own concept of the old people we know, we tended to underestimate the abilities of the elderly. In terms of interface design, this group seemed to have strongly restricted our liberty and

experimental approaches. We had to remind ourselves not to become patronizing and to keep in mind that we were not our own target group.

INDIVIDUAL IMPRESSIONS THROUGH CARD SORTING

We felt that our impression of the milieu groups was rather stereotype. To create a more precise image of our customers, we decided to conduct some card sorting sessions (Faiks and Hyland 2000) with representatives from each user group. The outcomes of these sessions were quite different from the persons we had developed. First we talked to two individuals and found out their preferences in detail. One was a female retired pediatrician, aged 67. She mentioned that she had used the internet to gather information but did not have further experience with mobile phones or computer interfaces. The other interviewee was a 36-year old male science assistant, a computer scientist with a lot of technical knowledge. He claimed to have high demands on the aesthetics of his mobile phone, and that appearance was an important factor in his decision-making process for a certain device (Fig. 1).

Then two interviewees were asked to select their favorite features out of a collection of common mobile phone functionalities and arrange them into a menu structure. They could explain their decisions and mentioned what functions they would like to have on their phones.

Surprisingly, the elder woman asked for a multi-purpose device with a full keyboard and a voice recorder. Despite her poor computer knowledge, she had the patience to learn the essential functions of her cell phone. She had also expressed long-term and precise ideas about what features she wished to add to her device.

On the other hand, the computer literate businessman had rejected the diverse functions provided on his mobile phone. He clearly preferred to have several devices for different functionalities and used his phone only to make phone calls. His attitude resulted primarily from his high requirements on security issues. He even rejected using the same phone for business and private issues.

These two interviewees reveal that even if our personas could provide a good average idea of our customers, there will always be individuals who do not confine to our scheme.Conducting card sorting sessions makes us realize that individuals are always more complicated than we might expect.

Figure 1: Card sorting session with an elderly lady

Although we have only conducted the card sorting sessions with two people, the results were still important and enriching complements to the user survey. While the survey could provide comparable information in a short and abstracted form, we also needed to involve real people in the project in order to understand their complexity and unpredictability. For this project, these two very different research methods proved to be a good combination to provide a wide set of impressions for the design process.

USER REQUIREMENTS AND FUNCTIONAL FRAMEWORK

To get an idea about the required functions, we investigated comparable online configuration tools. We looked at recurring patterns and similarities and collected best-practice examples.

The scenario descriptions, the card sorting sessions results and the research together served as a broad basis to define user requirements. For our framework, we have identified the following core functions that are valid for all three user scenarios:

The content of the mobile phone should be accessible - a hierarchical structure with folders, subfolders, application and varying content. Most phones have similar hierarchical structures. The nesting can be surprisingly complex and contains numerous items. Due to the limited screen space, only a small part of the menu can be shown at a time, and the user has to keep in mind about the current position within the structure. The configuration tool should provide abstract remote access to the menu structure on an extended display area of an average computer screen.This can be achieved by applying the display and interaction approaches for hierarchies developed in information visualization research.
The concept of a small handheld device that can be remotely accessed by using a PC is already in use, e.g. for music players and cameras. However, our prototype could alter the functions of the device, not only the content. This is possible for mobile phones because they are already multifunctional, in contrast to a digital camera or an MP3-player, which are specialized in use. For multipurpose mobile devices, a remote personalization tool can be useful in general as it can simplify the device with the desired functions.

A representation of the mobile phone should be displayed for providing feedback to the current changes and to display the appearance of the menu. While the display of the content display provides a meta-level for changes, the mobile phone representation should reflect the look and behavior of the actual device. We planned that the virtual display of the device would be a preview version of the real phone. The buttons should be active so that users could try out the changes before making them. This step is especially important for changes in the menu or the shortcut assignment. The virtual mobile phone screen should always show the menu screen selected in the menu hierarchy.
To use visual representations of hardware devices as an interface metaphor is a popular approach, because users are already familiar with the handling of the device. In our case, the visual mock-up of the mobile phone primarily has a preview function to check if the changes have the desired effects. Showing a visual representation of the device whose structure and appearance should be changed can be generalized to other comparable situations, as it provides high control and immediate feedback to the user.

Average users often change their mobile phones together with their contracts. To offer an incentive to keep up with the market and to use the personalization service beyond the initial configuration, users should also be able to purchase new features and themes.Therefore we included a New Features Library where users he could browse the choice of products. The most

prominently shown proposals should already be rated by the underlying personalization framework according to the user's interests.

FIRST ITERATION: FINDING THE RIGHT INTERACTION LOGIC FOR EVERYONE

For the actual design process, we decided to start off with a broad range of alternatives, then sort out the promising ideas and test their validity through rough prototyping. This should lead to a consistent and robust interface design.

To find some inspiration from the field, we had looked for helpful best-practice interaction examples which could match our case. We had also collected favorable interaction and visualization ideas for the kind of information we wanted to display in addition to an extensive visual brainstorming session about interface metaphors. In rough sketches, we tried out all sorts of possible interaction principles and combined and varied the auspicious examples (Illustration 4).

Sketching is a fast and cheap tool in which adjustments to the concept can be made easily.However, this method already forces the designer to substantiate his/her first ideas to a state where limitations and problems become visible.The designer can also test out a huge variety of visualizations for the same conceptual interaction model and select the best one. Sketches are also an efficient way to discuss ideas ast. he designer has to explain his/her idea to the group to receive their feedback about comprehensiveness, consistency and visualization quality of the concept.In addition, sketches are a substantial part of the work documentation as they make the visual reasoning process transparent to other stakeholders.

Working with interface metaphors can lead to particular solutions and facilitate the perception of interfaces. In this project, we used a wide variety of metaphors on different levels, for the whole interface (interaction principles) as well as for single functions (visual metaphors, icons). Every metaphor brings its own logic that the designer transfers into every detail. Reusing familiar knowledge in a different context, metaphors can be fast and easy to learn. They can also address the particular knowledge of a certain user group.

With the chosen interface examples, we then built paper prototypes and documented all important interaction steps to find gaps in the concept (Figure 2) (Nielsen 1995, Snyder 2003). For the remaining utilizable designs, we went on with first screen visualizations (Figures 3-6).

The configuration tool should be able to access the mobile phone menu while providing a quick preview on visual alterations (such different in"themes", as sets of graphics for the whole phone operating system are often called) the menu. For the menu hierarchy, a comprehensive visualization of nested structures was needed. In information visualization, several display and interaction concepts have already been developed for different kinds of nested hierarchies. The adequacy of a certain approach depends on the size and depth of a hierarchical structure. In this project, we needed a kind of interactive visualization that fitted the average depth and size of the menu so we considerably tested different approaches, trying out spatial arrangement, visualizing free and occupied space, abstract structures, metaphors for sorting and arranging items. Because it was crucial to show the device representation as a preview, we made much effort to locate a conceptual interface model where we could join the mobile phone's appearance and the display of the menu structure in a natural way. In the first case, the phone served as a preview while in the second, it was only the menu's container and; the structure had to be displayed outside the device.

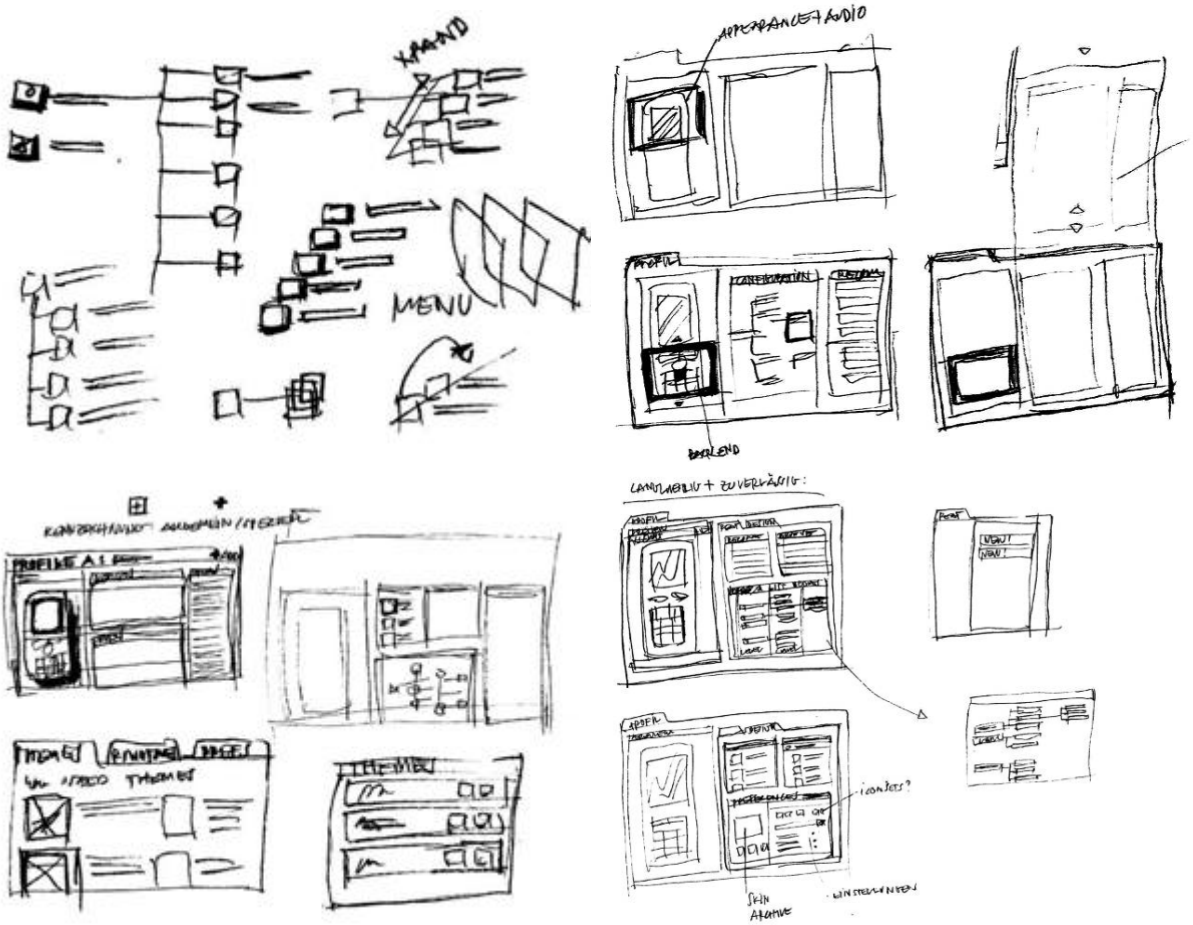

Illustration 4: Sketches to try different layouts, interaction principles and visualizations.

Figure 3: Paper prototype of a spatial building block approach for the interface.

Figure 4: Screenshot that shows how an opening and closing function gives access to the menu content.

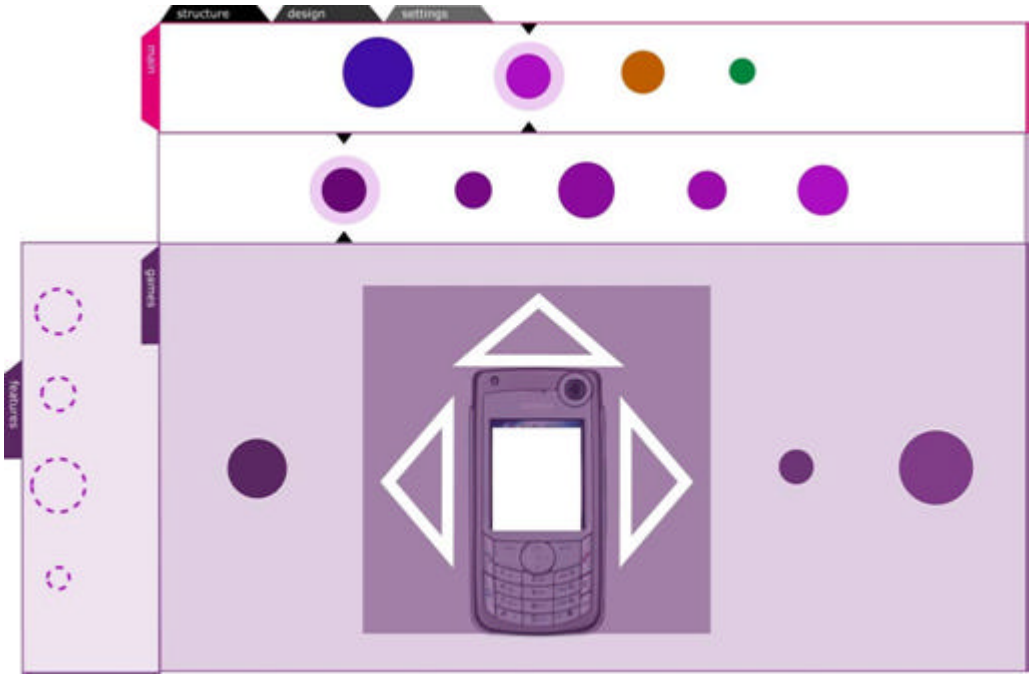

Figure 5: In this screenshot, hierarchical layers can be expanded and collapsed. The device serves as a looking glass for the highlighted feature.

Figure 6: The mobile phone menu cascades out of the device's representation on the screen.

To evaluate whether a conceptual model would work or not, we had two criteria: (1) Could it integrate the whole range of the desired functions without major usability constrictions?(2) Would the three personas understand the model? These two criteria were highly dependant. Our aim was to simplify the operation of the mobile phone. It would be inconsequential to provide a complicated interface to allow simplification. Our design had to be comprehensive. Our evaluation showed that some conceptual models could only cover some of the functions without getting intricate and most of them were too advanced to be understood by all users.

Soon it became clear that we would not find a single interface metaphor which fitted all three user groups.As a result, we developed our own picture of the persona's abilities concerning some ideal interface properties such as directness, visibility, control, consistency and conformity with the user's expectations (Deutsches Institut für Normung e.V. 2007). This is a general appraisal that might as well be applied in another design context, as it only provides an informative basis to the user's behavior. These properties for each user group are listed below.

"Eva", the elder woman, may have general problems with computer interfaces. To make her feel like she is in control, all functions should be clearly visible and labeled. Also consistency is very important. It will be difficult to predict what Eva knows already but she probably has some basic knowledge of dthe most common functions of desktops and web interfaces. Therefore a high level of directness could either please her, if she gets the conceptual model right; or it may annoy her, as it assumes interaction principles like drag and drop as established.

"Clarissa", the businesswoman, cannot afford much learning time.Therefore she might favor high consistency and also conformity with familiar applications that she uses. If the interaction is based on known principles, visibility (like buttons labeling) will not be too important. The importance of directness is judged according to its practical value; if it improves efficiency, it is convenient.

"Alan", the teenager, could possibly handle even quite inconsistent and exotic interfaces. He has the time as well as the experience to experiment with new and uncommon interaction principles. Visibility therefore is not that crucial but directness may be all the more interesting.

For the interface design, it would be helpful to have secured knowledge of the users' preferences. Designers do not only need to understand a user's attitude to certain contents but also his/her priorities concerning interaction. User taxonomy based on interface attributes rather than on concrete interaction examples as described above, can be of general help in balancing out conflicting interests.

Our aim was to build a simple and comprehensive interface. During the prototyping phase, we asked ourselves repeatedly whether we could expect our customers to handle our interfaces. Often, we discarded ideas that were logical and consistent, but not simple enough. We dismissed many ideas especially with regard to Eva, the old retired woman. She constantly reminded us to bear in mind the convenience of the interface.

Finally, we split up the interface into three different views, one for each user group. The functionality and position of the single interaction areas remained the same for each view. The feature library was always located on the right of the screen, the mobile phone preview appeared on the left, and the menu structure was located between these two. Only the location of the recommendation window was changed, as we merged it with the feature library in Eva's view. It was very important to keep the position of every function consistent due to human cognition (human beings rely heavily on their spatial and visual memory and will become confused when things move automatically).

For Eva, the configuration tool is presented as a wizard and a step-by-step instruction manual on how to add or delete features is provided. In this case,. we could significantly reduce the interface and stretch the process into several screens. Every step is clearly described to avoid any confusion and feeling of misuse and failure (Fig.7).

Clarissa's interface functions like a file browser with two lists - one for the new items and the other for the mobile phone menu. The lists contain folders that could be erased or expanded. The user only needs to drag a new feature into his phone menu to add it, or to press a trash- can icon to delete it (Fig.8).

Alan’s user interface has the same library list as Clarissa but with a more playful view on his menu. The menu structure is shown in a visual graph. To add a feature, the user should drag and drop the items into the menu tree (F.9figure).

For first-time users, short questions will be asked regarding their usage habits. The configuration tool illwould then automatically choose an appropriate interface view. Later, the user could switch between the alternatives, if s/he prefers another one. The function and position of the single windows remain static.

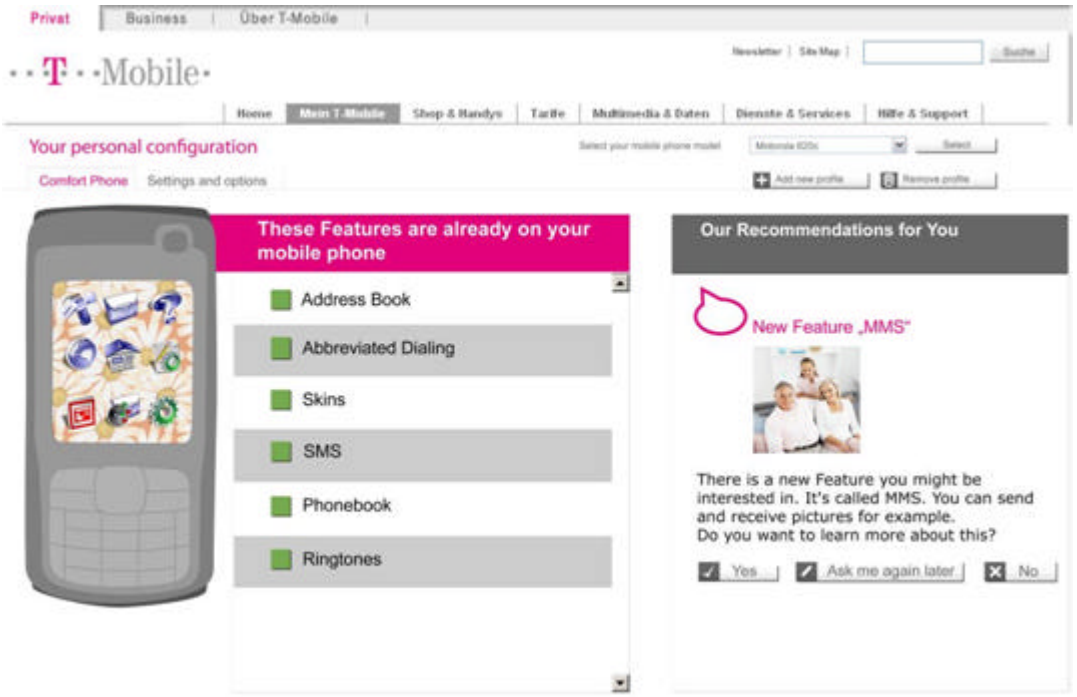

Figure 7: Screenshot of Eva's version of the mobile phone configuration tool

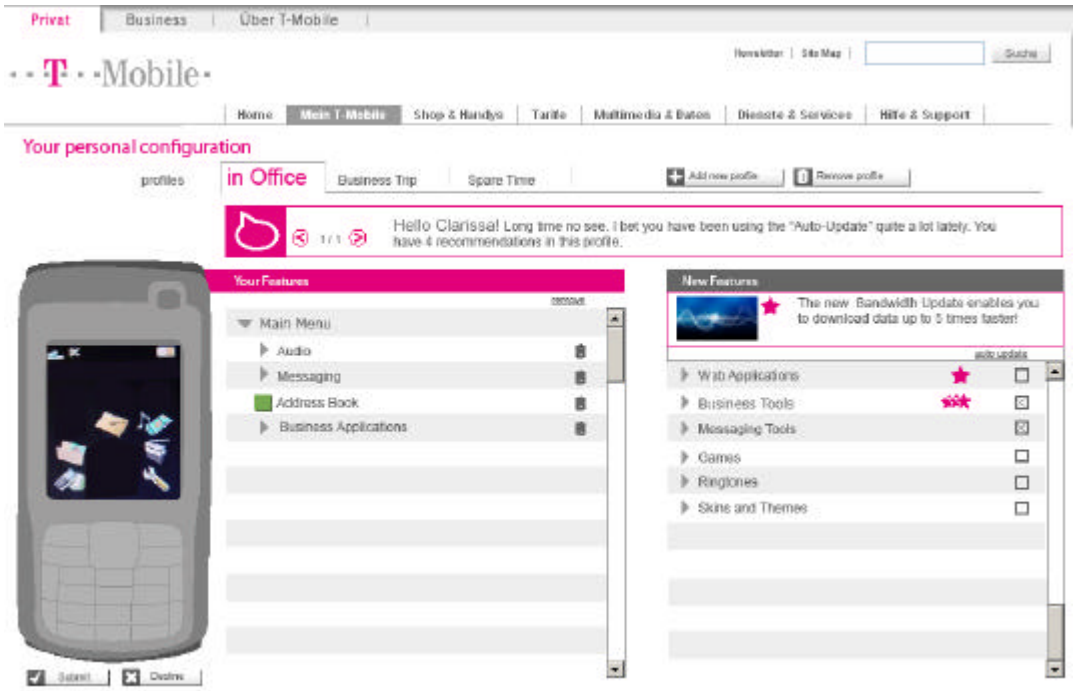

Figure 8: Screenshot of: Clarissa's view of theconfiguration tool

Figure 9: Screenshot of: Alan's view of the configuration tool

FIRST EVALUATION: DO THE SCENARIOS FIT?

External usability experts conducted an acceptance study within focus groups on the basis of the user scenarios. These experts also reviewed the designs according to industrial norm definitions for human-computer interfaces.

The results of the user evaluation were encouraging. Two of the three focus groups could perfectly relate to our personas. Both the elderly group and teenager group considered their scenario as most appropriate and said that their needs and preferences were accurately represented. Only the business people criticized the presented scenario was idealized and that it was not realistic. They argued that they would not use their mobile phones for massive data transfers and that they might be easily annoyed by frequent automatic recommendations.Despite these comments, the business people appreciated the easy profile administration.

The study also revealed that all focus groups enjoyed the features described in the other scenarios. Since we did not intend to restrict the functions of one scenario to one user group only, it was useful to see that their individual interests still differed greatly despite the accurate persona descriptions. From the study, we also noted the elderly group users were highly sensitive to the wordings used in the interface. They might be easily offended and felt patronized by some of our labels which they immediately interpreted as to be taken out of control, even if it was nowhere to be found in the scenario.Therefore we tried to avoid this problem in the next iteration.

The results of the expert evaluation provided even more arguments for a carefully designed user interface which strengthened our position towards the executing computer scientists in our team whose main interest was the implementation of the underlying framework. The usability expert's critique, however, emphasized the importance of feedback and visibility. Despite their serious critique on our work, these experts basically served as our intercessors in the project.

SECOND ITERATION: INTEGRATING VARIOUS INTERESTS

Since our actual interface design did not explicitly show how to switch between the three alternatives, we decided to merge them. Although our personas were quite close to reality, we could not predict the interface preferences of our user groups. Therefore we let the individual user decide which interface s/he would like to use.

The configuration tool now consists of four areas:

- the device preview which does not vary except that one could choose the phone type from a dropdown menu;
- the abstract representation of the device's menu structure, either as a browser-like list or as a graphical map;
- the New Feature Library, as a browser list or a step-by-step linear installation wizard;
- an area for recommendations and status messages.

Alternative views could be accessed via tabs on top of each area window. In this iteration, we also provided more control for the recommendation window. The user could modify the recommenation window size and the frequency for the recommendation messages (Fs.10-11).

To design this generalized interface, we had argued about the interaction modes we should provide. Acting in a browser, the established and familiar form for interaction would be restricted to links and buttons. With new web technology, we could also offer drag and drop functionality, which we thought to be easier to handle. However, a serious disadvantage about drag and drop was that it was not visible, while links and buttons could be labeled. In the end, we decided to provide multiple ways to add a feature to the phone menu, drag and drop as well as buttons. We justified this with regard to the focus group of the elderly. We did not know if they were familiar with the drag and drop function and if they would transfer their knowledge to a browser window.

The synchronizing process of the phone and also the browser environment also brought up another basic conflict. Our first idea was to add a special button to the interface that would submit the changes made. However, in case the user forgets to use the button, the changes will then be lost once the browser window is closed. Alternatively, the user may accidentally delete or move items without being able to undo his actions. Therefore we decided to execute all changes immediately and paid extra attention to avoid unintended actions. The results was every purchased feature could be added again without paying a second time once it was deleted from the phone and purchase processes were accompanied by a message window announcing the amount to be charged.

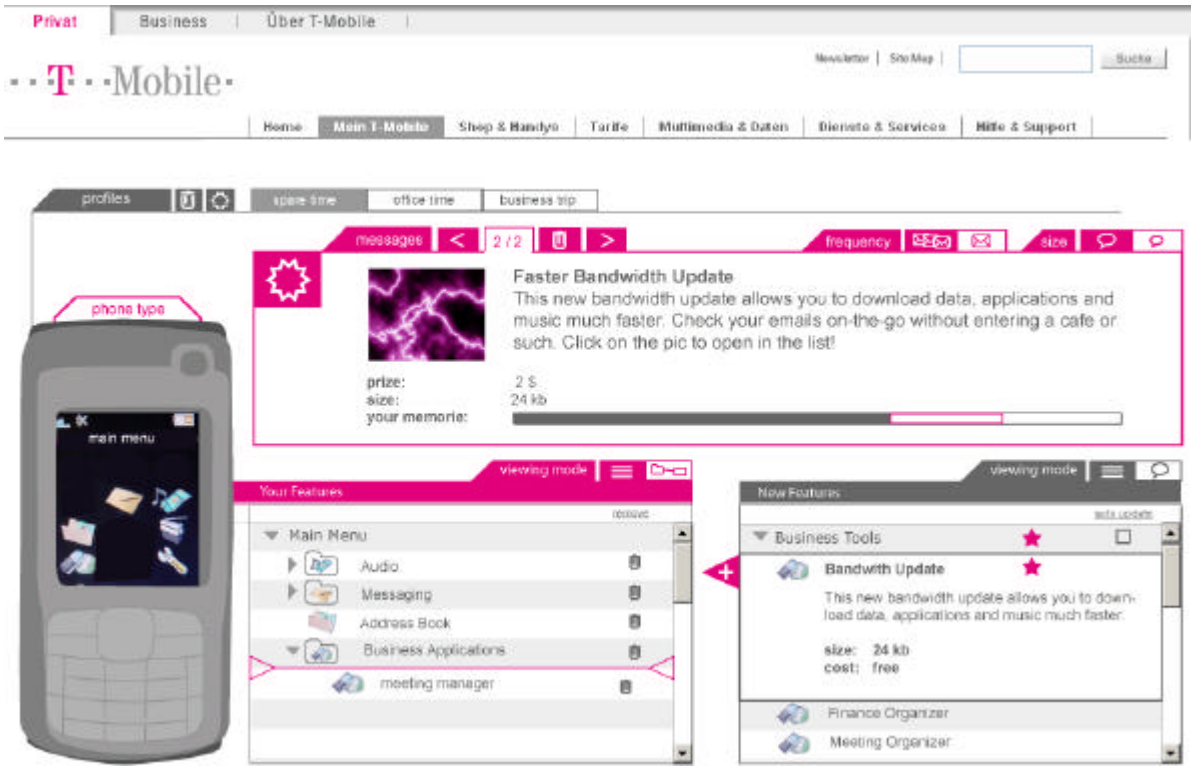

Figure 10: The revised interface with viewing mode tabs, list view and extended recommendation window.

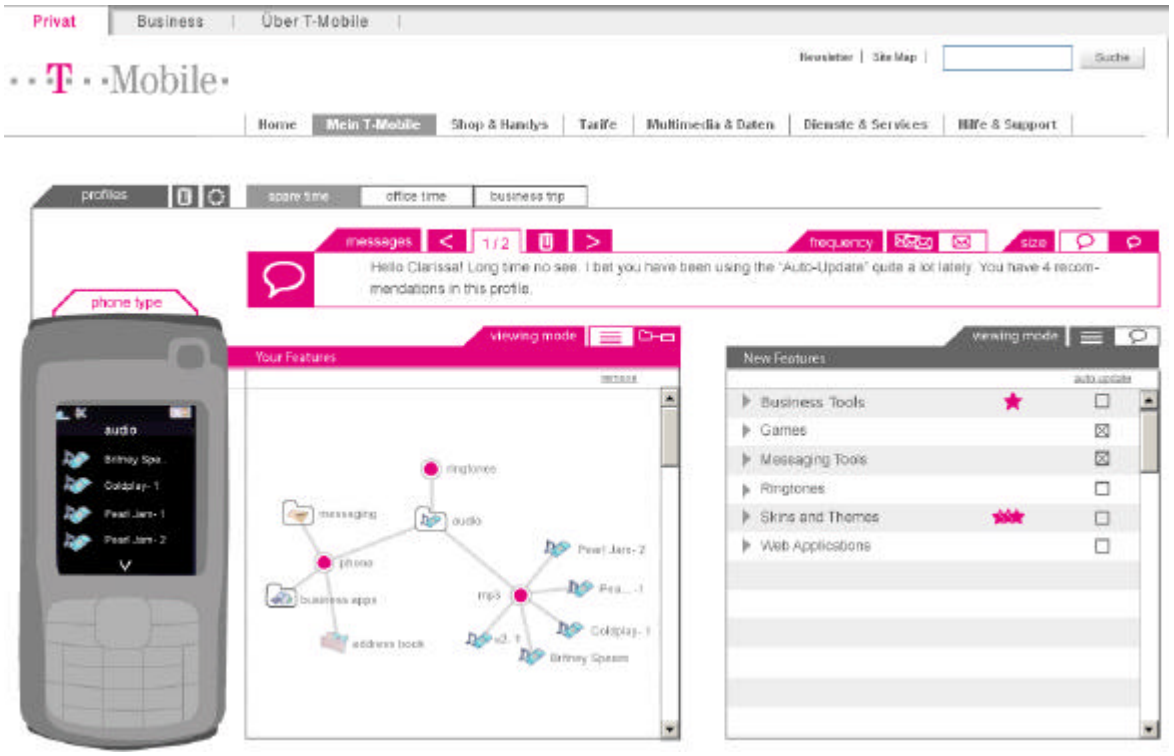

Figure 11: The interface with the menu map viewing mode selected and a small recommendation window.

CONCLUSION

The present report describes the use of design methods in a technical-driven research context to support the personalization of user interfaces. We have gained valuable experience from this project regarding both the iterative process and the applied methods. They can serve to transfer user requirements into an innovative product as well as to provide a usable interface for an innovative technical framework.

For the presented problems, designers show to be a valuable complement to computer scientists and market researchers. While market researchers contribute analytical data and engineers possess the technical knowledge, designers can synthesize conflicting values across disciplines. Furthermore, they can project both groups' requirements into a product. The capabilities of all three groups in combination are required to satisfy a user's needs concerning personalized interfaces. The iterative process of designing, implementing and evaluating constantly involved all parties in the project and ensured equality among the group members.

The design group has benefited from the detailed analytical information the market researchers provided. The transfer of the sociologic survey results into design requirements was easy and straightforward. It provided a well-grounded starting point to build persona characters and application scenarios. Although personas may be stereotype, the pictures were sufficiently accurate to help designers and computer scientists to consider the user's needs during the development process. In the interdisciplinary group, they proved to be an appropriate way to communicate users' attitudes.

The use card sorting to complement user surveys for user feedback has also provided us much insight about the user groups. When we had to evaluate our first design sketches, personas and market research could not give us valuable information for interface design. User knowledge concerning interface handling had to be discovered further as the same design might not be perceived in the same way by two different user groups.

Visualizing (from quick sketches to elaborated graphics) showed to be a very quick and efficient way to communicate within the team as well as with external partners (Schutze, Sachse and Romer 2003; Perks, Cooper and Jones 2005). We used sketches to discuss ideas among the design group, to make our decisions transparent to the whole team and to present our results to product managers.

Metaphors turned out to be an inspiring starting point for interface design. Every metaphor involves another set of solution for functional details. They therefore provide the opportunity of surprising knowledge transfers. If they are well selected, they can facilitate the understanding and handling of complex interfaces. Looking for appropriate metaphors can be a valuable source of innovation for designers.

However, the interaction preferences of different user groups remain an open question. Personas and scenarios could reveal the service demands but we need particular information about their interface knowledge and requirements. For future projects concerning interface personalization, user preferences should be examined via focus groups. Then a mapping between user groups and certain conceptual interface models may be detected. For further research, we will continue to develop different personas to represent different user needs and abilities. Interface usability can be better evaluated if it is not only assessed on a general level but with regard to the addressed focus groups.

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