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Shaping the Future of Mobile Devices

Results of the Workshop on Future Mobile Device User Interfaces at CHI 2000

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Introduction

Telecommunication is merging with information processing, intersecting with mobility and internet technology, creating the New Telecoms World.

Communication devices will be the largest consumer product segment in the world. Since we believe that it is necessary to increase and deepen research efforts to lay the foundations for "good" user interface design for this class of devices we organized a workshop during CHI 2000 which addressed the issue of UI design for future mobile devices.

User interface design for mobile communication devices has not been a central research topic in the past. Future communication devices will incorporate much of the functionality of today's information processing devices preserving important characteristics like the fact that the devices must be personal and highly individualized and increase the quality of life for their users.

Mobile communication and information processing is different from stationary communication and information access in its inherent nature of variable contexts of use, affecting the way in which the terminal is operated via its user interface, the quantity and quality of the content which user needs to access through the terminal, and the interconnections to other devices and services in users environment.

Currently a number of trends can be seen in the field of mobile communication which open up new design dimensions for mobile communication user interfaces:

- New applications and services such as mobile Internet access become possible.
- Communication networks become global. Devices are expected to react in an individualized manner.
- Convergence of information processing and communication.

What will tomorrow's communication devices look like in the context of these trends? Will we see a trend towards multifunctional devices or will there be many different personal information appliances with different user interfaces? And how will these future communication devices interact?

Topics of the Workshop

Four major topic areas were covered in the workshop, in order to answer the questions above. These areas have significant effect on the use of personal mobile devices.

Moreover, they are the major factors that differentiate mobile devices from the stationary office-based systems.

1. Context of use. Physical, social and cultural contexts affect the way in which the terminal is operated via its user interface. The quantity and quality of the content which users need to access through the terminal, and the interconnections to other devices and services in the users environment have their implications to the UI design. Being able to use the device anywhere, anytime is one of the major factors that differentiate mobile personal devices from stationary office-based devices like PCs.

2. Personalization of mobile devices is a central design issue. Mobility allows totally different degrees of personality even to the extent that new paradigms of personal computing seem to be arising. However, there seems to be very little research so far on the nature and extent of the personalization of devices. Moreover, the effects of the context of use on the personalization have not been explored before in relation to personal mobile products.

3. Applications and services are the driving force from the end user perspective. The variety of individual needs implies the necessity to offer tools to fulfil users' "mobile needs" such as fun, work and personal communication.

4. Connectivity and inter-working of communication appliances. We do not believe that there will be one "universal communication appliance" in the future, but a variety of communication appliances that are operating in harmony supporting users in their everyday life [2]. Communication and personal computing devices get more task specific, increasing the need for inter-device communication as the only way to simplify the task of the user in the most transparent way.

Contents and Schedule of the Workshop

The workshop was held as a one-day event. During the first phase, the 4 topic areas described above were discussed. The second phase included work in groups on a design exercise for the mobile user interface of the future.

The schedule included:

- Introduction to the topic by the organizers
- Individual statements and group discussion
- Presentation of results and plenary discussion

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- Scenario building and presentation
- Requirement list/design challenges
- Prototype building
- Prototype consolidation
- Summary and future actions
- Scenarios and their characters, requirements and resulting prototypes

Scenarios and their characters, requirements and resulting prototypes

Group I: Peter (35 years) is a family man who runs his media design company from home. He needs to attend to family affairs during the day and thus shifts between family and professional life. He must be available for clients at all times, and seem professional – even when out with his kids or dog. In addition, he has a special interest in comics and reads them regularly. He has a number of specific requirements for his device:

- The device should advise and remind Peter of his tasks and daily duties.
- The device should provide an instant and constant access to various data and mobile services.
- The device must have a large enough screen for comics reading.
- The device should help in hiding the personal life from the business partners, if so desired by the user.
- In order to appear professional he must be able to shift swiftly between work and home contexts (e.g. looking at business info while working in garden)
- Also, he wants his device to be fashionable and non-intruding. (This was a requirement stated for all developed prototypes.)



Figure 1: The armband prototype includes a large touch display, a camera, and an optional stylus.

in France, as well as a local host family, co-workers, and friends in Boston.

Here are some of Henri's requirements:

The resulting prototype was an armband solution with a large touch display and optional stylus (see Figure 1).

Group II: Henri (17 years) is a French exchange student in Boston who also works as a maintenance assistant on campus. He has his family, girlfriend, and other friends

- The device must be wearable and novel in design, and not become outdated; this can be achieved by flexible and customizable design.
- Henri wants an individual device and only the applications he needs. The device must be personalizable and grow with the user; this can be achieved for example by modular design.
- Use of maps requires a large screen, the system should be able to give directions. Also, the device must know its location and be context sensitive in offering the services.
- The device must support Henri to overcome his cultural and language barriers by e.g. offering translation services.

The resulting prototype was fairly similar to the one developed by group one. The device could be attached to the arm and contained a video camera and a removable earpiece.

Group III: Mattias (15 years) is a schoolboy from Rotterdam living with his parents and sister. He has a physical disability – he uses a powered wheel chair.

Mattias is an active teenager and enjoys hanging out with friends. He is an enthusiastic soccer fan. He often needs to find restaurants etc. with accessibility possibilities. He often needs to operate doors and different kinds of devices (e.g. vending machines) remotely. He needs to collaborate with his mates at school and in his free time.

Sample requirements from Mattias include:

- In general, the device must extend his physical and social abilities, by empowering him in a context-sensitive manner. For example, the device should be able to communicate with and operate other devices. Also, the device should help him manage physically demanding situations such as moving in crowds.
- The device must be intelligent to the extent that it can learn Mattias' preferences. Since Mattias likes to make new acquaintances, the device should work as an intelligent "matchmaker" or mediator (e.g. meeting new girls).
- The device should support social acceptability. It helps Mattias to know more than his friends (therefore looks cool). Also, being technologically advanced makes friends curious on the abilities of the device (e.g. friends can communicate with video).

The resulting prototype was named the "Wearable Pet", a device in the shape of a stuffed animal. The parrot contains a display under the wing, speaker output in its mouth, a microphone for speech input, and it is controlled mostly by natural language. For Mattias to be able to find his way and get good views in crowded environments the parrot has an extendable telescope head which extends Mattias limited abilities.

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Figure 2: The “Wearable Pet” supports Mattias in his daily-life activities.

The device has almost unlimited power resources (from the wheelchair) and can therefore contain large processing and memory capacities (see Figure 2).

Group IV: Barbara (22 years) is a medical student who also works part time as librarian. Her hobbies include photography, reading and out-

doors activities. She uses her computer, camera and GPS device as tools. She doesn't use technology just for technology's sake. Barbara has needs for note taking, info retrieval and sharing, she regularly listens to music and she is very fashion conscious! Her requirements include:

- The device must function as a wearable fashion item. Therefore it must vanish as a technology product and also be a designer item. The device must still clearly function as a utility tool.
- Task sequences and information flow must be seamless, e.g. the intelligent pen transfers the handwritten notes directly to the device.
- There must be a high quality camera in the device to support her main hobby. An earpiece must support non-intrusive music listening.
- Outdoors activities require small device size; therefore the display must be foldable and still big enough for note reading and picture handling.

The resulting prototype was a watch-size communicator, with earpiece (the "Bud"), a necklace containing microphone and camera, a foldable display for the representation of larger amounts of information, and an intelligent pen for free handwriting (see Figure 3).

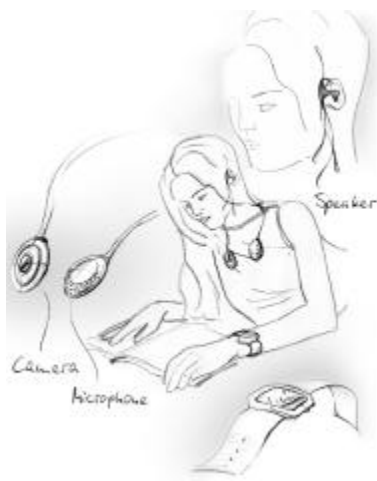


Figure 3: The watch communicator is a highly fashionable device. Text input is done with a stylus.

Common themes & solutions

Wearability

Three out of four of the prototypes developed in the workshop were attached to the body, and specifically to the wrist and arm of the user. This was a strong requirement from the scenarios: Users were highly mobile in both their professional and personal life, and the communication device must be instantly and naturally accessible, and must still not look "techy".

In addition to the "wrist-top metaphor", the wearability is related to the modularity: The necklace and earpiece were seen as a natural (and fashionable!) way of wearing input/output devices.

Non-intrusiveness

All groups clearly aimed at non-intrusive input/output techniques such as free speech recognition, continuous handwriting recognition, and large displays. Wearable items would not require constant attention. Devices are used mostly as practical *tools*, not as the center of their users' attention. (The Wearable Pet may be an exception but even it is not seen as piece of technology but a "companion".)

In particular, none of the prototypes included any kinds of implants nor head-mount displays that might close the user in some kind of virtual reality. All scenarios assumed non-intrusive technology related to social acceptability where there is a strong requirement for both remote and local communication (e.g. Peter who may have to talk to his kids in the middle of a business call, using his Armtop).

Social acceptability

In the workshop scenarios, Henri and Barbara were the users most concerned about looking "cool" and not as technology freaks. In addition, it is important for Mattias – who is sitting in a wheelchair – to be a respected member of his group of friends. Social acceptability of the wrist-attached prototypes became evident in their wearability and non-intrusiveness (see above), as well as in their fashionability (see below). In the case of the Wearable Pet of Mattias, however, acceptability is on an even higher level: His friends actually *admire* him for his intelligent and clever "companion". Mattias can "show off" to his friends and even attract attention of girls in a positive way.

Fashion and technology

Barbara is the most fashion-conscious of the scenario users. In addition, but perhaps on a less explicit way, being "on the leading edge" of new tools and devices is important to all users described

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in the workshop. The armtop concept of Peter even comes with different design versions (e.g. "grunge", imaging) which are clearly targeted at different user types.

In case of wearable technology, the related fashion items could be matched with clothing. For example, the modular items of necklace and earpiece ("the bud") included in Barbara's Watch Communicator concept are seen as pieces of jewelry, and should therefore match their users' taste.

Producing and marketing communication devices as fashion items may inherently mean shorter life-spans. It would then become a strong issue to consider the recycling of such products.

Multimodality

Each of the teams were free to explore different kinds of controlling devices and methods for their concepts. Multimodality both in inputting, outputting and controlling of the device was considered as a necessity: each of the designs incorporated several input and output methodologies. There seemed to be the tendency of designing for more ubiquitous and perhaps natural methods such as direct finger pointing, gestures and speech. The more traditional QWERTY-keyboard inputting technique remained nonexistent in the designs since none of the designs had a conventional keyboard or anything similar. General tendency towards allowing users to select the most appropriate modality depending on the physical context, usage situation, user's capabilities and preferences was clearly demonstrated in the designs.

Context awareness

Since one of the major themes in the workshop was *the context of use*, all of the groups paid a significant amount of attention to designing for a changing context. Different aspects of the context of use, namely cultural, social and physical, and balancing between them were explored in the usage scenarios. Designs were inspired by mobile communication allowing the constant change between professional and private life as well as public and private situations. All of the designs assumed some degree of context awareness: devices could sense neighboring devices e.g. vending machines. Based on that contextual information, the devices could turn to controlling devices for that short period of time. Some of the designs utilized location information to give user directions or map information.

Modularity

Final designs demonstrate various degrees of modularity of the physical design from a monoblock 'Armtop' to a highly distributed solution of the 'Watch communica-

tor'. Degree of modularity in the final designs seem to vary partly according to the requirement of fashionability: two of the modular designs both had the requirement for fashionability or 'coolness'. The more modular the product is the more ubiquitous it seems to become in the designs.

Discussion and Open Topics

What do the workshop results tell us about "Future Mobile Device User Interfaces"? It is interesting to note that all of the groups put heavy emphasis on and beyond the industrial design, coolness, and functionality of their devices, and we see a number of clear trends in the design field like modularity and wearability. The question of technical feasibility of the design models was never addressed and the prototypes require solutions that we don't expect to be available in the near future.

There were a number of technical solutions taken as given, both in hardware and software. Language independent technologies for text input like continuous speech recognition and handwriting recognition were taken for granted, also voice output was considered state of the art. The question of battery capacity and the effect on the weight of the devices and their components was not discussed during the workshop. The existence of broadband communication channels, both for local communication (between device components) and remote voice and data communication was also a prerequisite for all design models.

If we look at the applications required to fulfill the character's needs it is obvious that all the devices need to incorporate standard organizer functionality combined with context- and location-dependant services which are currently not available. We are, however, currently seeing the first of these context-services being implemented in mobile communication environments.

Why were three of the resulting prototypes fairly similar? We see a number of reasons for this outcome. Firstly the participant selection process obviously created a group of people with very similar interests and attitudes towards technology. Secondly, the workshop setup pushed the different groups towards designs that were unconventional and interesting at the expense of being fairly far-fetched and unrealistic in a medium term view. Thirdly, the narrow time frame prevented the groups from doing serious user-centered design. Given more time to analyze the characters in the scenarios and their technology requirements we would expect more differing approaches to the design of the mobile devices. We don't think, however, that these reasons fully explain the obvious similarity of the designs. There seem to be underlying trends in the users' (or design-

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ers') attitude towards technology which favor the design of wearable, lightweight and modularized devices which do not disturb the social contacts of their users.

The expected lifetime of the devices which were developed by the groups is another interesting topic. While three of the four devices follow the current trend in mobile phones towards shorter and shorter lifecycles the "parrot" clearly could be a lifetime companion for its owner. It would then have the same experiences as its owner and would be able to act as a personal agent and a memory support similar to Donald Norman's teddy bear [3]. The current state of technology will make it very hard to create a device similar to the parrot because technology gets outdated at an incredible pace, largely triggered by the advance of technology and functionality. Last year's mobile devices hardly fulfill the "basic" needs of this year's users. Even if you have a mobile phone from last year you won't use it, and, as a fashion-conscious user, you don't want to be seen with it in public. To create a companion which lives for more than a decade with you will require the possibility to change the underlying hard- and software during its lifetime.

What we also see in the workshop results is a fairly strong tendency towards creating tools and wearable fashion-items which are fairly non-intrusive. The joy-factor of using these devices seems to be secondary to the joy-factor of wearing and showing-off with your fancy devices. The importance of these "hedonistic" characteristics [1] for the success of consumer appliances cannot be overestimated.

The four scenario characters developed during the workshop were all fairly young, the oldest one being 35 years old. Although we believe that many of the design proposals will be beneficial to more senior users the validity of this belief remains an open question. Given the demographic development in highly industrialized countries it might be worthwhile to redo the workshop experience with a focus on older users of mobile devices.

What is the value of the "common themes" which we identified during the workshop? Did they show up just by accident or are they "signs of the time" representing trends important for user interface designers? While they make a lot of common sense, they differ very much from the "normal" marketing messages which we receive from today's manufacturing companies. We don't know the answer to this last question but we assume that in the medium term it will be answered by reality.

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