Towards Rapid Technology Probes for Senior People

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Abstract. In HCI, there is much interest in exploring novel technology-mediated communication that can empower older users who don't have easy access to regular computers. In this paper we exploit the potential of smart phones and tablet computers to create a series of technology probes that we deploy long-term making use of close family members. By this means participants can gain experiences with robust and fully implemented devices at a very early stage of design. We lay out four prototypes of communication technologies with different forms and functions for older adults. We describe the features of these devices including some indicative feedback from our informal deployment study. We thereby suggest that mobile phones are a suitable means for the rapid prototyping of communication technologies for senior people and can possibly provide useful input to later participatory or co-design activities. The overall work is still ongoing hence the main contribution of the paper is about the potential of rapid technology probes as a design technique and in less detail about the potential of the prototypes as AAL communication devices.

Keywords: AAL, Communication, Empowerment, Mobile phones, Older adults, Research Through Design, Tangible Computing, Technology Probes.

1 Introduction

Special need groups such as senior people often times get disconnected from their peers due to decreased mobility. To tackle this and related problems, researchers in HCI develop and explore technologies to reconnect those senior users and to grant them access to information over the Internet or cellular networks, e.g. in [1, 2]. User-centered design approaches and Participatory Design (PD) [3] or Co-Design [4] are common methods for creating such systems. In this paper we take yet another approach to this problem space and use a technology probe approach [5] that exploits the potential of new smart phones and tablet computers to enable the designer to test ideas at a very early stage of design. This means that we give various completely developed and robust prototypes to participants in order to provoke reactions and to gather feedback from the prospective users. This approach is also loosely related to Research through Design (RtD) [6] where artifacts are used to study segments of reality that would not exist and hence couldn't be examined without the artifact.

A key characteristic of the research endeavors in this paper, as compared to more bespoke and complex probe systems as in [5], is that we were able to develop the

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prototypes rapidly and with low resources due to the affordances of modern smart phones. To emphasize this, we introduce the concept of *rapid technology probes (RTP)* and argue, that mobile phone or tablet computer powered technology probes are an adequate and timely technique for the design process of AAL systems due to the opportunities offered by such 'off-the-shelf' devices. Technology probes based on mobiles provide the designers with quick feedback from the participants and allow them to quickly iterate their products. At the same time, the user experience of a working system is made accessible to the participants and potentially empowers them to be more educated participants in any later participatory or co-design process.

As such, we propose that RTP can complement established design methods such as PD and Co-Design. They can be employed after the initial understanding of the design context or user requirements gathering in order to probe experiences and receive meaningful feedback. Hence, RTP allows additional iterations with high-fidelity prototypes in the course of the advanced design process. Moreover, we argue that RTP can also be employed right in the beginning of the design process, as in this paper, for testing of ideas and receiving initial feedback or inspiration for further design concepts.

In the following, we describe a project for empowering senior users by means of Internet technology featuring four different prototypes. It is supposed to function as a case study or showcase for illustrating what kind of devices can be created relatively quickly, facilitated by modern smart phones and tablets. In this case the four prototypes presented are not direct iterations of one particular product. Rather they are different flavors of similar ideas and were deployed roughly simultaneously for the purposes of informally gathering user experiences with the probes. We conclude the paper with some exemplary insights gathered by means of the rapid technology probes and with discussing those qualities that all four probes have in common, which make mobile devices appropriate for rapid prototyping in AAL.

2 Related Works and Design Inspirations

Besides assistive technologies that have explicitly been designed for older users, there are a number of research projects where regular mobile phones are equipped with extra software to make the devices more accessible. For instance, Olwal and colleagues developed a software toolkit for customizing the user interfaces of phones according to accessibility needs [7]. Besides this kind of 'software-hacking' there are also efforts of hardware-modification where 'envelopes' mask or enhance certain buttons and functions. Panasonic's *Pixi* camera glove is a commercial example for this kind of 'hacking' and turns a regular phone into a camera for social networking.

Coleman et al. [1] investigated reasons for older adults not being interested in digital technologies. According to them older adults would accept technology when they can see a direct benefit. This can be easy access to information or getting in touch with family and friends. They also found that older users often show fear for technology, however they accept "invisible computers", that is computers that are not perceived as a classical computing machine [1].

An example for a suitable and more "invisible" technology is depicted in [8]. In this paper Spreicer describes the potential of tangible computing technologies for engaging older adults [8].

Focusing on the task of communication instead of tangible computing, Lindley et al. investigated the desire of older adults to stay in touch with their loved ones employing focus groups and prototyped technologies. They summarize that their participants accepted the idea of communication supported by technology, however, there was a strong desire of the older adults to have two-way communication, since they wanted to be able to contribute and not only consume passively [2]. We go on now to introduce our prototypes.

3 Rapid Technology Probes with Mobile Devices

In our project for empowering older users through Internet technology, we draw on features of the cited work from above to develop four related prototypes based on Android powered mobile devices: *TwoButtonCamera*, *Wired TabletCompanion*, *Wireless TabletCompanion* and *Integrated TabletCompanion*. Those devices function as the computer since they feature a decent performance and also give easy access to the Internet via a LAN or a telephony network provider. In addition, we employ Arduino microcontroller boards for the quick extension of the Android phones by, e.g., physical buttons or RFID readers and corresponding RFID reader antennas. *TwoButtonCamera* is a device for low effort and uncomplicated taking of digital photos and publishing them to a *photo-blog*. *Wired TabletCompanion*, *Wireless TabletCompanion* and *Integrated TabletCompanion* are designed to provide older users with no prior computer experience with an easy to operate computer and Internet.

Table 1. Approx. time spent working on different prototypes for an experienced developer

Prototype	Time spent on hardware	Time spent on softw.
TwoButtonCamera	8 hrs	10 hrs
Wired TC	10 hrs	20 hrs
Wireless TC	10 hrs	20 hrs
Integrated TC	10 hrs	20 hrs

As mentioned before, an important characteristic of the prototypes is that they can be created rapidly in relation to the complex tasks that they can handle. Table 1 gives workload estimations for an experienced developer. In contrast to a classic user-centered design approach with subsequent iterations, we can run several test studies with different advanced prototypes in parallel and thus explore different directions at a time. This has the potential to quickly gather feedback from participants or co-designers that have been provided with 'real' user experiences and enables us to explore the design space together with users. Later, this feedback can be considered in further iterations by the designers. Also, possible follow-up workshops might benefit from the fact, that the participants have already been exposed to the experience of

high-fidelity prototypes. We leave these high-fidelity prototypes with the participants for a longer period of time as is common practice in various RtD projects. Thus, by denoting the devices as *rapid* technology probes, we do not necessarily mean that we also take them away quickly but rather that they were quick to prototype. In our case, we were interested more in informal feedback from long-term use. The work presented is still ongoing.

3.1 Motivation and Method

More specifically, our motivation was to use the potential opened by Android smart phones in combination with tangible computing components to explore easy to use communication technologies for older users. One principle that we employed was putting the Android devices into customized boxes, thereby covering some of the technical appearance of the phones as well as hiding interaction complexity (unnecessary buttons etc.). We also aimed at giving the prototypes a friendly tone by using wood as a material or painting the box. Besides being built into a cover, the phones were very suitable for attaching customized hardware buttons and shortcuts for hiding even more complexity.

In these ways the prototypes modify the appearance of regular smart phones in terms of their looks and software. The motivation for this was to reduce the fears of inexperienced users, to encourage them to interact with the devices and to ease their operation of the computers in general. This puts a different emphasis on 'accessible' computing compared for example to the efforts of the World Wide Web Consortium (W3C), which focuses on the interactions accessible by standardization guidelines. We want to not only ensure that there are the 'big buttons' to make it easier to operate but that the devices are also inviting to use, so that people can find their own value in it. For this they also need access to the devices over a longer period of time to undertake this exploration.

We have collected this informal, but long-term user feedback by exposing two of the designer's family members to the artifacts, since one of the driving motivations behind this project was to later provide those individuals with the finished devices. Both participants are female, have no prior experience with computers and are aged 65 (P1) and 86 (P2) years. Total amount of experience with the probe systems is more than a year for each person. Data has been collected by informal participant observation during visits with the family members and informal interviews. In addition, we have access to the photos and browsing history produced by the participants.

4 Probes and Informal Feedback

We go on now to describe each of the probes and point to some of the feedback from the informal long-term deployments.

4.1 TwoButtonCamera

TwoButtonCamera is the most straightforward device in terms of functions (photo-sharing). From a technical standpoint *TwoButtonCamera* (see Fig. 1) is an Android phone in a wooden casing with our custom software installed. However, to the user it is presented as an 'online photo camera' with the possibility to audio-annotate the pictures. Its purpose is to take photos, optionally attach an audio recording and immediately upload it to a web photo-blog, which has been implemented as part of the system. Family members and friends get automatically pushed email notifications as soon as a new photo is available on the blog. The interaction is designed to be as simple as possible and demands only 2-3 button touches. Hence, it is a technology that enables user groups that don't have easy access to online photo sharing to document their life, capture functional photos (e.g. an image of an important newspaper article to be send to friends) or to simply enjoy themselves by taking creative or appealing pictures. It lets them contribute digital photos and stories actively, which is an activity usually performed by younger adults.

Fig. 1. *TwoButtonCamera* prototype (left) and birthday greeting note including a vase with flowers captured by P2 and sent to a relative (right)

TwoButtonCamera – Feedback. Each participant (P) was provided with a TwoButtonCamera and has been using it for approximately half a year. P1 captured 44 photos and 7 audio annotations. P2 took 40 images, 6 with accompanying audios. The feedback about the device was very positive and usage frequency was constant over time since they did not lose interest but continued using it at special occasions. However, both participants decided most of the time not to use the audio annotation to skip that extra effort and because they "liked providing pure visual messages" (P1). Common triggers for use as shown across the collected images were *sharing of experiences*, virtually *giving presents* in a somewhat tangible way (see Fig. 1, right), *documenting visits* of friends/family and *sharing messages* such as photos of newspaper articles.

4.2 TabletCompanion

The *TabletCompanion* (TC) is a product- or prototype-line for exploring how Internet computers could be designed to be understandable and convenient to use for senior or inexperienced users. Currently three devices are in use: *Wireless TabletCompanion* (Wireless TC, Fig. 2 left), *Wired TabletCompanion* (Wired TC, Fig. 2 right) and

Integrated TabletCompanion (Integrated TC, Fig. 3). Overall the *TabletCompanion* series of probes has different form factors and different levels of assistance (help buttons, video tutorials). Still, all versions of TC have the same set of supported programs (writing and reading e-mails, reading newspapers, watching videos, reading the weather, watching photo-blogs of family and friends, etc.).

Wireless TC (Fig. 2 left) is a peripheral radio module with a build in RFID reader. Switching the device on will pair it with an Android tablet. Placing RFID tokens on the device will trigger various actions on the Android tablet, for instance starting the e-mail client. Of course, the Android device can still be operated conventionally. It is not mandatory to pair the devices, the Wireless TC is meant to be of help when the users get stuck. Accordingly, there are also RFID tokens that will start short tutorial videos or audio guidance for the user-intended actions to be performed on the tablet. In this regard, it is important to note, that a certain kind of context awareness can be implemented easily on the Android devices: it can be learnt from the operation system what kind of task is being performed by the user at the moment, e.g. writing an email to uncle Tom. As a consequence, we can explicitly offer guidance on how to write a message to that uncle. Wired TC (Fig. 2 right) is very similar to Wireless TC (Fig. 2 left), but it is connected to an Android tablet by a USB cable. It features additionally quick access buttons for common tasks such as opening a text field for triggering a web search. *Integrated TabletCompanion* (see Fig. 3) integrates a tablet into the companion. It has a bigger form factor with space on it for taking notes.

Fig. 2. Black, 7-inch tablet computer with *Wireless TabletCompanion* and various RFID tokens (left). *Wired TabletCompanion* with four quick access buttons and three RFID tokens (right).

Fig. 3. Integrated *TabletCompanion* with 10-inch display (left and right). The device features several quick access buttons and space for notes by the users. It comes with a wooden casing (right) for easy and appealing storage.

TabletCompanion Feedback. Both participants were equipped with a *Wireless TabletCompanion* for permanent use about a year ago. Five months and four months ago P1 was provided with an additional Integrated TC and P2 with a Wired TC. However, after about two months they were asked to switch devices to provide them with the experience of both flavors of the *TabletCompanion*. All are still in use.

In general the devices were perceived as nice, not frightening and useful. In particular, the Wireless TC was appreciated for its small form factor and the possibility to more easily store or hide it away. This was important to both participants because of their desire to "not have too many things lying around" (P1). However, its drawback compared to the Wired TC was that it was used less frequently due to a small but still existing pairing effort. They also tended to forget about it lying in the drawer and, as a consequence, operated the Android tablet less often. This seemed not to be the case with the Wired TC that always sat next to the Android tablet or phone.

Integrated TC is the complete merging of *TabletCompanion* and the tablet computer, i.e. with it the user only has to mentally deal with one artifact. According to our participants they benefited from having to learn and work with 'only one' single new device. Also, the extra space around the screen was appreciated where they could attach their own notes for explaining the functionalities of the system. P1 and P2 both preferred taking their own notes in contrast to having predefined explanations (e.g. "Google search", "push when lost"). Surprisingly, P2 preferred to use the Wireless TC (often times even without the RFID) module, despite her appraisal of the improved usability of Integrated TC. In this case having the device stored away and setup up again quickly (in order to have a "tidy room") obviously was more important than a larger device with improved functionalities and guidance.

The most popular applications of the TC series comprised the email client, visiting photo-blogs of friends and trying to find information e.g. on craftsmen services by means of web search engines. Both participants made heavy use of the RFID tokens and the customized hardware buttons especially during the first weeks of employment when they haven't had a lot of practice yet. E.g., "I like having a real object for starting programs, because this makes the program more like a real thing, it gives it a face" P1 said. They both reported that the design of the prototypes helped them lose their over-exaggerated respect towards computing devices and the fear of breaking the system, because it didn't look like conventional technology and enabled them to have an impartial go on the computers. An interesting observation was that both participants treated the TC increasingly like a conventional Android tablet (ignoring TC helper functions) as their confidence and computer skills grew over the time.

5 Discussion and Conclusion

In summary we introduced four examples of rapid technology probes for establishing digital communication channels for senior users. What the prototypes have in common is that they could be developed relatively quickly. This was due to the capabilities of modern Android devices and easy to program microcontroller boards such as the Arduino. The wooden casings also gave the technologies a 'solid' non-threatening

appearance that made them more appealing to the participants than traditional computers, and made them robust enough for long-term deployments. In addition, two more features accounted for that robustness: While the mobile Android devices provided a stable technological backbone, the tangible computing components assured robust or intuitive interactions and hence made the user experiences accessible. As a consequence of the relatively low-cost development process, we were also able to quickly incorporate user feedback into the later prototypes (e.g. quick access buttons) and deploy these new versions in a real life setting where the participants again could fit these devices into their everyday practices.

Having family members as participants turned out to have the advantage that they were not shy about giving unmasked opinions. To date we have also had several demands to fix some broken (minor) features of our prototypes. We see this as an indicator for their true demand and interest to ensure that they still operate.

Reflecting our observations of this ongoing field study so far, one of the most striking insights is that both P1 and P2 were very eager of not only consuming digital content, but rather to also actively generate emails and photo messages. For future work we will therefore consider this by supporting these user needs even more directly. As there was also great desire for revisiting photos, it might be interesting to explore more interactions around going back to created content and around digitally supported creative engagement for senior people more generally (e.g. extending the photo taking device and study). Such insights can also complement other approaches such as PD or Co-Design and serve as initial experiences to seed these processes. As mentioned before, the work in this paper is still ongoing and the focus here is on RTP as a design technique. Hence, studying the proposed prototypes with regards to their potential as an AAL communication device in more detail also is for future work.

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