Designing a Smartpen Reminder System for Older Adults

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CHI'13, April 27 – May 2, 2013, Paris, France.
ACM 978-1-XXXX-XXXX-X/XX/XX.

Abstract
Designing interactive systems for older adults often means designing *with* older adults from the earliest stages of development. This paper describes the co-design of a smartpen and paper calendar-based reminder system for the home. The design sessions involved older adults and used *experience prototypes* [1]. We completed these co-design sessions with older adults in order to explore the possibility of exploiting paper-based calendars for multimodal reminders systems using a smartpen. The initial results demonstrate successful interaction techniques that make a strong link between paper interaction and scheduling reminders, such as using smartpen annotations and using the location of written reminders within a paper diary to schedule digital reminders. The results also describe important physical aspects of paper diaries as discussed by older adults, such as daily/weekly layouts and binding.

Author Keywords
Co-design; Reminder Systems; Older Adults; Smartpen Systems, Prototyping.

ACM Classification Keywords
H.5.2. Information Interfaces and Presentation: Input devices and strategies.

Introduction

Reminder systems can help people managing their daily lives in the workplace, at home and on the go. This is particularly important in the area of independent living technologies, where an electronic home reminder system could be used to support older users in managing their health, wellbeing and activities of daily living. Such reminder systems, if successful, could mean the difference from effective independent living in one's own home and the need for assisted living in sheltered housing. In order to be successful, these systems have to be both usable and acceptable to a range of users, including computer novices and older adults with sensory impairments. Previous work has looked in great detail at the design of usable *output* for reminder systems [8][][]. Our research focused on creating usable *input* and *interaction* with reminder systems by exploring paper-based interaction using a smartpen.

This research is part of an on-going project that is working with groups of older adults (aged over 60) to explore the design possibilities of digital reminder systems. Specifically, this work is exploring linking paper-based calendars to digital reminder systems using smartpen interaction techniques. Using paper-based interaction builds on what our users are already familiar with, and when combined with smartpen technology can be used as input for a digital home reminder system. Our research explores how to best combine paper-based interaction and digital reminder system on a tabled PC using smartpen technology by completing design sessions with older adults.

The following section briefly review reminder systems, pen and paper-based interaction, and designing with and for older adults. We then go on to present our co-design sessions and our initial results. Our current work is utilizing these findings to inform the design and deployment of a home reminder system.

Designing Reminder Systems for Older Adults at Home

Electronic reminder systems can help users organise their daily lives. These systems are commonly used in the work environment to notify users of upcoming appointments and tasks. In the home environment, they can alert users to the state of their home (a window is open), to remind them of upcoming appointments (visit doctor at 2pm on Tuesday) or to organise their daily living (take recycling out on Wednesday). Reminder systems have also been used to remind users when to take their medicine, when to eat meals, when to take care of personal hygiene and when to check in with their adult children [6]. Given the wide range of preferences and abilities of users of home care technologies, multimodal interaction provides the possibility for creating more customisable and accessible systems [3]. Previous work has looked in great detail at using multimodal output for reminder systems [8].

Interaction with Pen and Paper

Pen-based interfaces have been popular in systems for older users because of the familiarity of the interaction technique. In the case of diary and calendar entry, smartpen interaction with paper calendars closely resemble users' existing practices [2] and therefore could be exploited as an input method for a reminder system.

Piper et al. developed a smartpen and paper system for older users in speech therapy [4]. It used paper buttons and graphics that could be interacted with using a smartpen, where users could hear and record audio

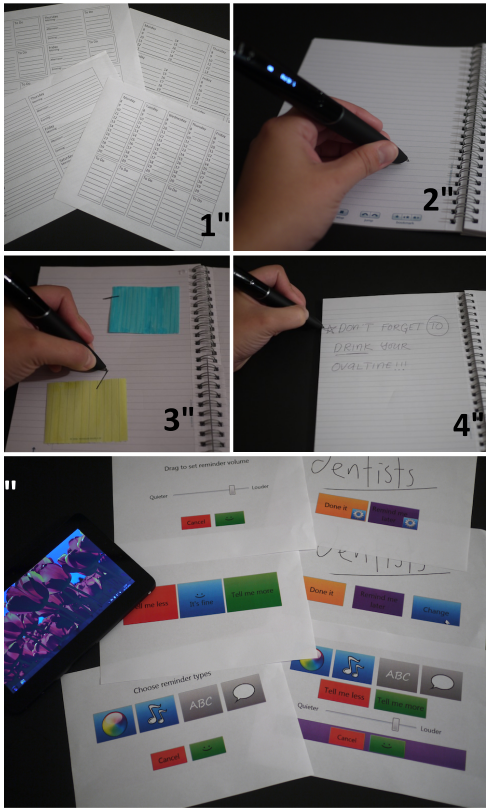

Figure 1. Experience prototypes used in design sessions. 1: Calendar layouts. 2: Voice Annotations. 3: Smart Sticky Notes. 4: Calendar Annotations. 5: Configuration Interfaces on a tablet PC.

through the paper-based interface. This work demonstrated the usability of multimodal smartpen interfaces for older adults. Plaisant et al. developed a shared calendar system based on a series of cultural probes, workshops, and case studies [5]. The resulting deployment used a smartpen to digitize paper calendars belonging to older members of the family combined these with others' existing digital calendars. The results showed that sharing was possible but that calendars needed to be stable and consistent in order for adoption to be successful. In our work, we hope to build on these previous results by adding new functionality to paper calendars using smartpen interaction. Beyond digitizing paper calendars, the concepts we explore look add automatically scheduled digital reminding based on these paper calendars.

User-Centred Design with Older Users

Involving users in a design process can take many different forms and adapting these processes to include new user groups and new contexts is essential. This is of particular importance when including older users and users with sensory, physical and cognitive impairments [6]. Many traditional user-centred design techniques fail to adequately consider the particular challenges of older users [7]. Focus groups and design sessions like the ones used in this paper are popular because designers have the opportunity to interact on a more personal level and explain their motivations. However, one problem with this approach is that users may have trouble imagining what the technology or concepts in question are capable of now or in the near future. This makes eliciting requirements for future healthcare applications challenging. Our work aims to address this challenge by engaging with older users in co-design sessions using *experience prototypes* [1] to drive discussion. Experience prototypes are designed to give users the opportunity for hands on interaction and experimentation with new ideas and concepts.

The following section describes how we made use of experience prototypes in our design sessions and the resulting outcomes for the design of reminder systems that combine paper and digital elements using smartpen technology.

Co-Designing with Older Adults

In order to incorporate older adults into our design process, we completed a series of co-design sessions with participants over the age of 60. During these sessions, participants explored a range of paper calendar and smartpen prototypes to demonstrate the possibilities of using paper-based interactions with a smartpen as input to digital reminder system on a tablet PC. We used *experience prototypes,* which are prototypes specifically designed to provide an experience, support hands on interaction and allow participants to explore how new interaction techniques might work in practice [1].

The Prototypes

The design sessions revolved around five experience prototypes: paper calendar layouts, annotations with a smartpen, voice recording with a smartpen, smart sticky notes, and a reminder configuration interface on a tablet PC, as shown in Figure 1.

The paper calendar layouts consisted of different designs (layouts with hourly time slots versus morning/afternoon/evening slots and vertical versus horizontal weekly views) of the kinds commonly found in commercially available diaries and calendars (Figure 1, 1). The annotations prototype was demonstrated with

Figure 2. Participants' paper calendars and current reminding strategies.

a smartpen and dot paper and supported underlining, circling or adding a star (Figure 1, 4). The voice-recording prototype used a smartpen to record voice notes by holding the pen on the paper. When the paper was touched, a tone played to indicate the beginning of the recording and played again when the pen was lifted from the paper to indicate the end of recording (Figure 1, 2). The smart sticky notes were created from smartpen dot paper and demonstrated on a dot paper notebook (Figure 1, 3). These sticky notes could be "linked" [2] to anywhere on the notebook by drawing a line between the sticky note and the notebook. A chime was played after this action to indicate these two were now successfully linked. The reminder configuration interfaces were demonstrated using a tablet PC with additional paper walkthroughs of the screens (Figure 1, 5). Two prototypes of possible interfaces were demonstrated, the first using multiple screens where each configurable item was presented on its own screen and the second using a single screen showing all configurable items in a simplified form together.

Each of these prototypes demonstrated how paper-based input could be used as part of a digital reminder system. Paper calendar layouts showed how the location of written reminders on paper could be used to automatically schedule digital reminders on a tablet PC. Adding annotations, such as an underline or star, could be used to indicate important or urgent reminders. For example, any reminder marked as "important" could be accompanied with a tone or chime when presented on a tablet PC. Audio could be added to calendar entries using the voice-recording function on a smartpen. This could be displayed with a reminder when a user needs additional information or when impairments make written reminders difficult. The smart sticky notes mimic users' existing practiced to annotate calendar entries with additional information. The smartpen makes it possible to capture this information and link it with times on the calendar. The configuration prototype on a tablet PC demonstrated how reminders could be interacted with and customised after being captured using the smartpen. Together, these prototypes gave participants the experience of using the smartpen and its connectivity with paper and a tablet PC.

The Design Sessions

Before each design session, participants were requested to bring their own calendars or diaries to share with the group, as shown in Figure 2. The sessions followed a simple structure, lasting roughly 90 minutes, beginning with a discussion of participants' existing calendar organization and reminding methods. Then, each experience prototype was demonstrated in the order presented above. For each prototype, participants discussed what they liked and disliked about the prototype and scenarios where its functionalities might be useful. Finally, each session ended with a general discussion of the prototypes overall and a debriefing on the purpose of the session itself as part of the design process.

Results

We completed two design sessions of three and four participants for a total of seven participants. The participants were aged 71 on average with a standard deviation of 7.5 years and were recruited from the local community. Data gathered from these sessions included observation notes, audio recordings, and photographs of artefacts brought by participants. The following section presents an overview of the resulting themes from these design sessions.

Smartpen: Linking Paper and Digital Systems
Adding annotations to calendar entries using the smartpen received positive feedback during the design sessions. This capability has promising applications as input to a digital reminder system to customize and control how reminders are displayed. For example, reminders with a star next to them could always be displayed with a tone or chime to make them more salient. Reminders that are underlined could be used to denote a repeating reminder to automatically schedule subsequent reminders. Participants specifically wanted flexible and self defined annotations, so configuration interfaces should include options for mapping annotations to different functionalities in a reminder system.

Even though recording speech notes might be completed more quickly than writing the same number of words, participants overall did not see the need for adding speech notes to paper calendars. One problem with this functionality is that there is no clear link to the paper aspects of the reminder system and a speech note and no strong comparison to existing reminding approaches. For example, none of our participants used voice recorders to keep track of daily living. This is one case where the technology is present but making a useful link in this interaction context was difficult. Participants also had difficulty imagining scenarios for the smart sticky notes and had understanding the purpose of the "linking" gesture. Although participants often used sticky notes in their paper calendars (see Figure 2), our smart sticky notes were not popular. Participants did not see the added value of "linking" a post-it note to a particular time using a smartpen gesture when the physical placement of the note already seemed to link it to its current position. In this scenario, the linking gesture did not reflect existing practices and was difficult to understand in this context.

Paper: Form and Layout
The size and binding of paper calendars was important. Many of the participants used bound diaries (roughly size A6, 105×148 mm) that could easily be carried in a purse or pocket, as shown in Figure 2. When discussing our paper calendar prototypes, which were printed on A4 paper, the lack of the A6 bound form was a major problem. Participants had difficulty imagining how they might use these paper calendars in their daily lives, which highlighted the importance of the physical form of the diary.

The paper calendars with hourly time slots were extremely unpopular amongst the participants and didn't resemble their existing calendars, which had an open space for each day. Based on this, we would aim to provide a minimal structure to aid with scheduling reminders while maintaining flexibility. Participants also highlighted the importance of having blank open areas in calendar layouts for additional notes and to do lists.

Configuration: Simplicity and Flexibility
Configuration and personalisation proved to be an important feature during these co-design sessions. Participants described simplicity as an important aspect of the configuration interface. The prototype that made used of a single screen for all configurations was more popular than the multiple screen interface. On our configuration interface, aspects of the system such as the appearance of reminders could be changed and personalised. Participants also described the desire to change the timing of reminders and customize how reminders would be scheduled.

Discussion

This work is part of on-going research to design and deploy usable reminder systems for older adults. During these co-design sessions, participants highlighted important aspects of reminder system that we are currently putting into practice. When using smartpen technology to capture input on paper calendars, our participants discussed the importance of making a strong link between the paper and the reminder system. Some of the interactions supported by the smartpen supported this better than others. For example, adding written annotations to calendar entries mimics existing practices well but also adds the opportunity for configuration input on paper. Using the location of written reminders to automatically schedule digital reminders also makes a strong link between the paper calendar and the reminder system. For example, any reminders written on a Monday morning could automatically be displayed on a tablet PC at 9:00 AM on Monday. This minimises the burden on the user to input specific times and makes scheduling and receiving reminders simple. If users want more control over scheduling, this can be made available as an additional option. Supporting simple input with the option of additional interaction if desired is one design goal that paper-based interaction with a smartpen supports well.

Conclusion

This work-in-progress informs the design of reminder systems that explore paper-based interaction with a smartpen as input. Our results describe the functionalities of smartpen interaction that are the most usable by completing co-design sessions with older adults. From these results, we will pursue two key design goals; to support the simplest input possible while still creating a sophisticated experience and to mimic as much as possible users' existing reminding strategies.

Acknowledgements

This research was funded by the EPSRC MMH Project.

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