The Book as User Interface: Lowering the Entry Cost to Email for Elders

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ABSTRACT
Substantial stumbling blocks confront computer-illiterate elders. We introduce a novel user interface technology to lower these start up costs: *the book as user interface,* or *BUI*. Book pages contain both step-by-step instructions and tangible controls, turning a complex interaction into a walk-up-and-use scenario. The system expands support past the technical artifact to a *go-to* relationship. ElderMail users designate an internet-savvy trusted friend or relative to help with complex tasks. In this paper, we conduct a preliminary evaluation of a BUI-based email system, and report our findings. While research has augmented paper artifacts to provide alternate access into the digital world, we find that elders use the BUI as a way to circumvent the digital world.

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Ubiquitous computing; tangible user interfaces; CMC; BUI; seniors; aging

ACM Classification
H.5.2. [Information interfaces and presentation]: User interfaces --- *input devices and strategies*.

INTRODUCTION
Research into aging describes its degenerative effects on the cognitive, perceptual and motor capabilities of elders [14]. HCI research often takes this knowledge and seeks to support aging by augmenting existing computing with new features that account for elders' declining capabilities [17].

While this approach supports elders who already use and understand desktop computing without adversely affecting existing users, only 22% of those over 65 say they go online at all [4]. Given the increased time required for training [2], and the known barriers of access, skill, and intimidation [4], elders with no computing experience face a significant challenge if they desire the increased social connections [13] and feelings of independence [8] technology use can provide.

To address this problem, we introduce a novel technology specifically designed to lower these barriers to entry for literate and physically and cognitively able elders with no computer experience – the *book as user interface*, or *BUI*. To explore the concept of the BUI, we introduce the ElderMail system, a prototype stand-alone email device that uses a BUI to guide user input (see Figure 1).

The BUI lowers technology start-up costs in several ways. Like many tangible interfaces [5,16], the BUI leverages elders' understanding of how to interact with real-world objects. Users turn book pages instead of clicking buttons. ElderMail users send and receive letters instead of email. They use address picture-cards instead of email addresses.

Next, the serial BUI pages break complex tasks down into a series of small, digestible steps. This wizard-like interaction constrains unsuccessful user interaction.

Lastly, the ElderMail BUI extends support beyond the technical artifact. Elders designate a trusted and technically-literate *go-to* relationship. The system contacts them to provide low-cost, stop-gap help for complex interactions. This obviates the need for elders to learn the conventions and jargon that surround email configuration and use.

Unlike other systems that provide a tangible point of access into a digital world, ElderMail replaces the need to access a digital world by designing a system that supports the *entire communication process*.

This paper describes the design and preliminary evaluation of ElderMail. We begin with related work.

Figure 1. The ElderMail BUI provides tangible access to email using an "instruction book" as the user interface

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RELATED WORK

Previous research has explored alternative email systems for elders. For example, [2] provided elders with a simplified, desktop email client. This work extends that concept to everyday objects.

Other research has explored introducing computation to the world [15], or to tangible objects [5,16], particularly paper and books. For example, [12,10] augment paper artifacts with digital information. Other systems use paper to bridge the electronic and physical worlds [9, 16, 11, 7, 10], or enhance a book with controls for sound output [1, 10].

This paper builds upon these concepts by undertaking a significantly more complex interaction than has been attempted previously. While these systems use paper as a point of entry into the digital world, they seek to simultaneously manage both paper artifacts and digital information. ElderMail, however, uses digital technology to entirely circumvent technical artifacts.

Like [7], the ElderMail BUI replaces the complex set of tasks involved in composing, sending and receiving email with the familiar ritual of letter-writing. ElderMail brings this work off the desktop, and extends it to walk-up-and-use context.

DESIGN STRATEGY

Six semi-structured interviews with email-using elders informed the design of the ElderMail prototype. Participants reported points of computer failure almost every day. They described problems with concepts, vocabulary, and interactions involving not just email but the computing environment itself. They consistently stated that these failures affected their independence, forcing them to rely on a primary "helper" relationship to facilitate their use of a computer. These observations suggested the following design strategy to address this situation:

Replace the computer with the familiar

The ElderMail BUI replaces the overhead of computing with a tangible interface that utilizes familiar objects and their affordances [5]. It replaces the email application with the process of writing letters by hand. It also simplifies the functionality of email into a series of tiny, easy-to-understand steps.

Book tabs indicate high-level goals

The ElderMail BUI is divided into *chapters* using *physical tabs*. Each chapter represents a high-level user goal. The device currently supports three goals: send mail, get mail, and make a new address card. Users communicate their goals to the system by opening the BUI to the chapter that represents their goal. For example, to send mail the user opens the book to the "send mail" chapter.

Hidden, nested tabs reveal in-context instructions

High-level goal tabs visually occlude a series of *nested tabs*. After opening the BUI to a chapter, the series of sequential nested tabs (numbered 1 through *n*) leads users step-by-step to accomplish that chapter's goal. Each nested tab page contains a single instruction. Instructional pages are cut so that they expose only those controls necessary for that single step. Instructions physically surround the cutouts.

Physical cards replace email addresses

Since email addresses represent additional information to learn, integrate and manage, ElderMail replaces the email address with physical address cards. Users create a card for each person in their address book by writing their name (and attaching an optional photo). Each user is given a dedicated personal card that identifies them to the device. They can also give cards pre-programmed with their address to others. Users then insert cards into the device to indicate who they are, and to whom to send letters

Leverage a go-to relationship

While we strove to develop a system that would require as little external support as possible, we also chose to recognize, support and incorporate external support from trusted relationships into the system. Each ElderMail user appoints a designated *helper,* who provides low-cost support through the system.

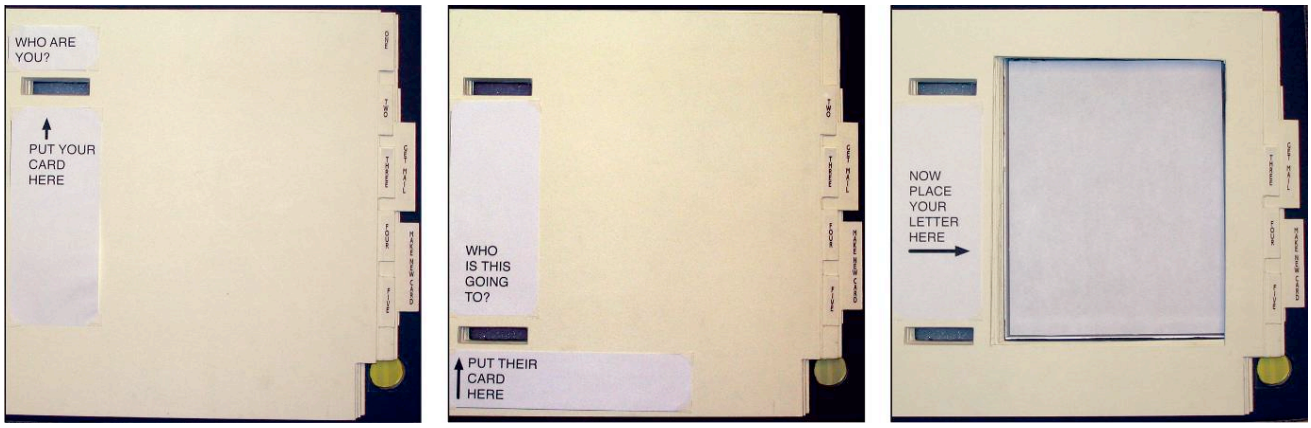

Figure 2.
(a) User inserts RFID identifying themselves to system

(b) User inserts RFID card that identifies recipient in the new slot

(c) User places letter on the now visible scanner.

To create address cards, for example, elders write the name, address and phone of the new person on a piece of paper. ElderMail sends the request to the helper. The helper then secures the email address of the new person and enters it into the system via a web-based form. This obviates elders from managing the address book process.

HOW IT WORKS

The following example scenario describes how ElderMail may be used. Gert, a 67-year-old retired teacher, wants to send a letter to her daughter, Dorothy.

Gert writes a letter by hand on a piece of paper. To send it, she opens the ElderMail book to the "send mail" chapter, which reveals five nested tabs. First, Gert inserts her identification card (Figure 2a) into the sole exposed cutout. When she turns the page (Figure 2b), she finds a new cutout and instructions, which ask her to insert a card for Dorothy. The next page (Figure 2c) asks Gert to put her letter on the scanner. The next page prompts Gert to press the device's only button. The last page instructs Gert to wait for printed confirmation, which comes out the side of the device. If an error occurs, an error message is printed instead.

Dorothy then receives an email from Gert, with the scanned letter attached as a JPEG image. She replies immediately. To get Dorothy's response, Gert only has to follow three steps: (1) identify herself; (2) press the button; and (3) wait for the reply to be printed.

Later that day, Gert decides to send her first email to her grandson, Charles. Gert must first create an address card for him. She opens the book to the "create new card" chapter. After identifying herself to the device, Gert affixes a wallet-sized photo of Charles onto a new, blank address card, and inserts it into the device.

Gert then writes a quick note that contains Charles' name and contact information. When Gert presses the button, the letter is sent to her "go-to" person, Dorothy. Dorothy receives an email asking her to "add the contact contained in the attached image. She is also sent a link to a web form.

If Dorothy knows Charles' email address, she can enter it directly. Otherwise, she can contact him with the information provided and request his email address.

Since Dorothy knows Charles' email address, she clicks on the link, and enters it into the web form. When Gert sends an email to Charles, the system will know to map the id in Charles' card to the email address entered by Dorothy.

IMPLEMENTATION

The ElderMail BUI sits on top of a box that hides a Philips Hitag RFID scanner, an HP printer/scanner, a HandyBoard [6], and a UPont micro PC running Windows XP.

A single button-press, communicated to the PC via the HandyBoard, initiates all system activity. The system first determines the state of the book by reading the chapter using RFID's affixed to each goal tab. The system then reads the user's RFID card, and, depending on the chapter (and user goal) the system scans for recipient cards using the RFID scanner, and/or optically scans the user's letter.

A Java client sends the scanned image and detected RFID codes to an ElderMail server, which then matches the codes with email addresses using PHP and SQL. For security, no personal information is stored on the local device. After authentication, the server attaches the scanned image to an email message, and sends it to the recipient from the user.

If sending is successful, the ElderMail server returns a confirmation. The client then prints a receipt containing a copy of the scanned transmission and the date and time sent. If an error occurs at any of the steps, the device prints out information about the error.

PRELIMINARY EVALUATION

As a preliminary evaluation, we compared ElderMail with the America Online (AOL) version 9.0 email client using a think-aloud protocol. We selected AOL to measure baseline performance for simplified desktop computing. Each participant experienced both interfaces and interface presentation was counterbalanced. Because our design targets walk-up-and-use simplicity, we provided no tutorial. Five participants were using a computer for the *first time*. The sixth described herself as a "complete beginner."

We asked users to check and send mail, and to add a new contact. Experimenters both intervened and noted critical incidents according to a pre-defined set of criteria. We then sorted and coded the reports for common themes.

AOL task performance failed to satisfy walk-up-and-use criteria. Only the self-described "complete beginner" completed the task with less than five experimenter interventions. Participant behavior consistently revealed that foundational windows and email concepts derive from *unfamiliar conventions*. Participants repeatedly clicked the right mouse button in place of the left, or typed without giving a text-field the mouse focus. Many entered physical street addresses in place of email addresses. One participant, when typing, asked "where's the space [bar]," unable to find a key with no real label. Not knowing these computing conventions derailed seemingly simple interactions.

In the ElderMail condition, users experienced considerably fewer problems. Three of six participants were able to send and receive email without any intervention. Problems with

Preliminary Metrics (n = 6)	AOL	ElderMail
Instructions clear at each step	3.33	4.83
Confident to use by themselves	2.83	3.67
Ease of task: write mail	3.67	4.5
Ease of task: send mail	3.33	4.5
Ease of task: add address	2.83	3.67
Feel independent	3.83	4.17
Physically easy	4.83	4.5

Figure 3. Select, preliminary metrics

ElderMail involved unclear instructions and insufficient feedback. Several participants, for example, inserted and then removed their identification cards. This prevented the system from identifying their cards on button-press since their cards were not present.

Participants completed a post-survey to evaluate perceived ease-of-use and feelings of independence. The survey used a 5-point scale from strongly disagree to strongly agree (see Figure 3). Participants rated ElderMail above AOL on eight of 13 questions. Eldermail scored around a four or better on nine of 13 questions. AOL scored a four or better on only five of 13 questions. This suggests that both the ElderMail tangible BUI interface and the single, serial instructions contributed strongly to the system's ease-of-use. Interestingly, AOL scored higher for "physical ease-of-use," which we attribute this to the eccentricities of the physical prototype.

CONCLUSION

In this paper, we have presented a preliminary look at the book as user interface, or BUI, and the ElderMail system, which provides a tangible interface to email for elders. The BUI interaction style presents two advantages. First, it provides an interface that is more familiar to our elderly users, essentially circumventing the costs of unfamiliarity and potential interaction problems with desktop computers. Second, the interface and instructions are integrated to help the elders step-by-step through the email processes of sending, receiving and adding addresses.

We believe the book as user interface presents a contribution towards the UbiComp vision of invisible computing [15]. By hiding the computer, we believe we are lowering the barriers to e-mail for elders, so that they might benefit from the power of computing and live more independently. System usage by elders confirms our design hypothesis that familiar objects can remove the experience of intimidation and help elders to use computing independently.

We intend to continue to evaluate the effects of the ElderMail interface, and its impact upon a community of users. ElderMail currently only supports a subset of the overall functionality found in email. We intend to introduce a more robust set of functions. We also intend to evaluate the social impact of access to computer-mediated communication that use of ElderMail might bring. We are also interested in evaluating the impact of the go-to relationship.

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REFERENCES

1. Back, M., Cohen, J., Gold, R., Harrison, S., & Minneman. S. (2001) Listen Reader: an electronically augmented paper-based book, *Proc. of CHI'01*, 23-29.
2. Czaja, S., Guerrier, J., Nair, S., & Laudauer, T. (1993) Computer communication as an aid to independence for older adults. *Behaviour & Information Technology*, (12)4: 197-207.
3. Czaja, S. & Lee, C. (2001) The internet and older adults: Design challenges and opportunities. Charness, N., Parks, C. & Sabel, B. (Eds) *Communication, technology, and aging: opportunities and challenges for the future,* New York: Springer, 60-78.
4. Fox, S. (2004) *Older Americans and the Internet*, Pew Internet & American Life Project, http:// www.pewinternet.org/pdfs/PIP_Seniors_Online_2004.pdf
5. Ishii, H. & Ullmer, B. (1997) Tangible bits: towards seamless interfaces between people, bits and atoms, *Proc. of CHI'97,* 234-241.
6. HandyBoard, http:// lcs.www.media.mit.edu/groups/el/projects/handy-board
7. Heiner, J., Hudson, S., Tanaka, K. (1999) Linking and messaging from real paper in the Paper PDA, *Proc. of UIST'99*, 179-186.
8. Henke, M. (1999) Promoting independence in older persons through the Internet, *CyberPsychology & Behavior*, 2(6): 521-527.
9. Johnson, W., Jellinek, H., Klotz, Jr., L., Rao, R., Card, S. (1993) Bridging the paper and electronic worlds: the paper user interface, *Proc. of CHI'93*, 507-512.
10. Klemmer, S., Graham, J., Wolff, G., Landay, J. (2003) Books with voices: paper transcripts as a physical interface to oral histories, *Proc of CHI'03*, 89-96.
11. Lange, B., Jones, M. & Meyers, J. (1998) Insight lab: an immersive team environment linking paper, displays, and data, *Proc. of CHI'98*, 550-557.
12. Mackay, W. (1998) Augmented Reality: Linking real and virtual worlds, *Proc. of AVI'98*, 13-21.
13. Malcom, M. (2001) Computer and Internet use in physically frail elders, *Physical & Occupational Therapy in Geriatrics*, 19(3): 15-32.
14. Salthouse, T.A. (2000) Aging and measures of processing speed, *Biological Psychology*, 54: 35-54.
15. Weiser, M. (1991) The Computer for the 21st Century, *Scientific American*, 265(3), 94-104.
16. Wellner, P. (1993) Interacting with paper on the DigitalDesk, *Communications of the ACM*, 36(7): 87-96.
17. Worden, A., Walker, N., Bharat, K., Hudson, S. (1997) Making computers easier for older adults to use: Area Cursors and Sticky Icons, *Proc. of CHI'97,* 266-271.