Re-finding from a Human Information Processing Perspective

Uma Murthy[1], Ingrid Burbey[2], Gyuhyun Kwon[3], Nicholas Polys[1], Prince Vincent[3] and Manuel A. Pérez-Quiñones[1]

[1]Department of Computer Science, Virginia Tech

[2]Bradley Department of Electrical & Computer Engineering, Virginia Tech

[3]Grado Department of Industrial & Systems Engineering, Virginia Tech

{umurthy, iburbey, ghkwon, npolys, prince, perez}@vt.edu

ABSTRACT

In this paper, we discuss re-finding personal information from a human information processing perspective. We describe the design of a prototype that explored the human information processing aspects of a personal memex (a memex to organize personal information). In the project, we considered the use of the personal memex, focusing on information recall, by three populations: people with Mild Cognitive Impairment, those diagnosed with Macular Degeneration, and a high-functioning population. The outcomes of the project included human information processing-centered design guidelines for the memex interface, a low-fidelity prototype, and an annotated bibliography for human information processing, usability and design literature relating to the memex and the populations we explored.

Keywords

Human Information Processing, Memex.

1. INTRODUCTION

Consider the following scenario.

April Greenside, a young woman in her late-twenties, recently started training for long distance races. Sometime back, April acquired a personal memex in the hope that it would help her in her daily activities and her new endeavor. It has been about a year since April started using her personal memex, and today, she wants use it to recall instructions given by her doctor two weeks ago. She queries her memex for the terms "Dr. Smith", "Tuesday", "Montgomery hospital". The result set includes details of her session with Dr. Smith. Clicking through, April browses from the details of the session with Dr. Smith to pictures of a Yoga workshop that she attended three months back, to details about the instructor, the location, other people who attended the workshop with her, and some of their phone numbers.

This scenario depicts a use of the memex, a device proposed by Dr. Vannevar Bush in 1945 [3]. He described the memex as, "a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility". Although some of the capabilities mentioned here might seem futuristic, the steps involved in finding, and then recalling information is what is generally practiced today and has been around for a while. We make use of retrieval cues to recall information, which in turn leads us to more information (or browsing through information).

Now imagine the use of the personal memex if April had mild cognitive impairment (MCI), a condition where many areas of cognition are affected such as language, attention, critical thinking, reading and writing, and where an individual may experience deficient memory. Or, April could be diagnosed with Macular Degeneration, a condition where central vision decreases and it become difficult to see details or recognize faces. How would her interaction with the device change? What could she see in the device that would help her recall all of the information related to her session with Dr. Smith? How would the device's interface change? How can the interface be customized so that the same device can change with the disease's progression?

We explored the human information processing (HIP) aspects of a personal memex. In the project, we considered the use of the personal memex, focusing on information recall, by three populations: people with MCI, those diagnosed with Macular Degeneration, and a high-functioning population (individuals with no apparent disabilities). The project involved a literature review of relevant cognitive psychology work on memory, prototype development, interviews with experts, evaluation in the form of cognitive walkthroughs, and HIP-centered design guidelines for a personal memex with focus on information recall. This paper describes our work and summarize our results.

2. RELATED WORK

Many researchers are studying different aspects of how we can use the vast amounts of information that is stored by our computers or in the future, memex-like devices. The Remembrance Agent [14] watches what an individual reads or writes, finds the key words, and displays the relevant parts of your documents, email or web pages. Lifestreams [7] displays stored documents as a timeline. The Haystack Project [10] is a general purpose information management system that allows users to link between different types of information, such as emails, documents, photo albums, or appointments, for the purpose of letting "people manage their information in ways that make the most sense to them."

Finding information that has been viewed before is an important aspect of systems that record a person's life. The Keeping Found Things Found project [9] studies how people organize and re-find their information, such as Web pages or documents which are part of large projects. In a user study, Capra et al. [4] found that task familiarity and task frequency impact re-finding information in Web pages. In another (uncontrolled) study, Teevan [15] found that factors affecting memorability of search results included their rank in the list, whether they were clicked and other factors like

number of times visited. Stuff I've Seen [6] provides an interface for a desktop user to re-find information such as e-mails, e-mail attachments, files, web pages or appointments. It allows the user to filter, sort and change the way the information is displayed. Several studies indicate an enduring preference for browsing (e.g., by going through a nesting of folders) as a means of return to information within a personal space of information (PSI) [1].

The research challenge of using these technologies to assist people with disabilities has been proposed. Researchers in England suggest that building a memory aid for elderly people with short-term memory problems is doable within 5 years [8]. Others see projects like MyLifeBits as the future in caring for people with disabilities [5]. A system is being built to use the automatic capture features of devices like the SenseCam [12] to capture the many details involved in intervention therapy done with autistic patients [11].

While much of the current research on organizing and displaying memex-like information focuses on work-related information, our focus is on personal use of the memex, outside of the office. In addition to personal uses by the high-functioning population, we also focused on two classes of users: individuals with Macular Degeneration and individuals with MCI.

3. PROJECT DESCRIPTION

This project began with a literature review to learn about human information processing principles and the needs of our special populations. We interviewed four domain experts on campus who work with students that require assistance and with the elderly. Bill Holbach is the Assistive Technologies coordinator and Hal Brackett is the Special Services Manager at Virginia Tech. The purpose of the Assistive Technologies and Special Services groups include facilitating equal access to technology for all students at the University by providing various computer-related assistive technologies, such as screen magnifiers, voice recognition software and accessible workstations. Dr. Karen Roberto is a Professor in the Department of Human Development and Director of the Center for Gerontology. Dr. Roberto's research focuses on health and social support in the later stages of life. Dr. Virginia Reilly is the Americans with Disabilities Act (ADA) coordinator in the office for Equal Opportunity and Affirmative Action at Virginia Tech.

It was outside the scope of this project to consider how information was collected, stored, or retrieved by the personal memex. We focused on the interface requirements necessary to best retrieve information for our different population groups.

Based on the literature search and interviews, we generated several scenarios demonstrating the possible uses of a personal memex. After choosing one scenario, a task decomposition was performed and an initial low-fidelity prototype was sketched out. To evaluate the prototype, we conducted cognitive walkthroughs with the domain experts. The final steps of the project involved refining the prototype and developing design guidelines. More details of these steps can be found in the complete report [2].

3.1 Individuals with Macular Degeneration

One of our populations we considered for this project was individuals diagnosed with Macular Degeneration. Macular degeneration is a chronic eye disease that occurs when tissues in the macula deteriorates. The macula is the part of the retina that is responsible for central vision. The retina is the layer of tissue on the inside back wall of your eyeball. Degeneration of the macula causes blurred central vision or a blind spot in the center of the visual field. This condition mostly occurs in the older population and hence it is usually called age related macular degeneration in some literature. Macular degeneration is the leading cause of severe vision loss in people age 60 and older. More than 1.6 million American adults have the advanced form of age-related macular degeneration.

With dry macular degeneration the following symptoms are observed:

- Colors appear less bright.
- Difficulty recognizing faces.
- Blurred or blind spot in the center of your visual field combined with a profound drop in your central vision acuity.
- Increasing difficulty adapting to low levels of illumination.
- Gradual increase in the haziness of your overall vision.
- Printed words that appear increasingly blurry.
- The need for increasingly bright illumination when reading.
- A need to scan your eyes all around an object to provide a more complete image.

With wet macular degeneration, the following symptoms are observed:

- Decrease in or loss of central vision.
- Visual distortions, such as straight lines appearing wavy or crooked, a doorway or street sign that seems out of whack, or objects appearing smaller or farther away than they should.
- Central blurry spot.

3.2 Individuals with MCI

Mild cognitive impairment can affect many areas of cognition such as language, attention, critical thinking, reading and writing. It can also reveal mild difficulties in other areas of thinking, such as naming objects or people (coming up with the names of things) and complex planning tasks. Mild cognitive impairments can cause a destabilizing effect on the normal lives of people affected by it and can lead to depression and other related conditions.

MCI can be divided into two broad subtypes. One subtype, amnestic MCI, significantly affects memory while the other type, nonamnestic MCI, does not. Other functions, such as language, attention and visuospatial skills, may be impaired in either type. It has been estimated that amnestic mild cognitive impairment converts to Alzheimer's at a rate of 10 percent to 15 percent a year.

There are no clear cut symptoms for MCI. Some of the commonly used guidelines for a diagnosis of amnestic MCI are:

- Deficient memory, preferably corroborated by another person.
- Essentially normal judgment, perception and reasoning skills.
- Largely normal activities of daily living.
- Reduced performance on memory tests compared to other people of similar age and educational background.

- Absence of dementia.

3.3 Development of the Prototype

After literature review and learning about our populations, we developed a low-fidelity prototype. We evaluated this prototype through a cognitive walkthrough process. This involved creating a scenario and a list of associated tasks. We then met with each experts to walk through the prototype, encouraging them to 'think-aloud' as they completed the tasks. The comments made by the experts were recorded and their suggestions were incorporated into the final prototype and the design guidelines.

Our prototype focuses on two features:

Interface Customization: In order to support different populations, we provided a feature that would allow users and caregivers to customize the appearance of different entities. For example, some people associate pictures with people, while others associate their name, or the buildings they live/work in. Or, in the case of locations, some people associate maps with them, while others associate pictures. For people with visual impairment, an audio option for most entities was assumed to be available (for example, a text to speech option for documents).

Information recall support: The find feature in the low-fidelity prototype is a series of browse and search functions that provides retrieval cues to help the user in recalling information. We describe this feature in more detail in the remaining part of this section.

We used the scenario of April, our long-distance runner, trying to recall information given to her at her last doctor's visit. The experts were given the following task list:

1. Find the instructions April received from Dr. Smith from her last visit.
2. Review yoga postures and exercises.
3. Find some information about yoga resources (classes and instructors) in the local area.

Using the 'Find Wizard' portion of the prototype, shown in Figure 1, our user begins to re-find the doctor's visit.

Figure 1 Easy Answer Questions for Re-finding Information

The user selects the first choice in order to search for information related to a specific person in her life (Dr. Smith). A screen like Figure 2 allows the user to scroll through a list of people that April met during a given time period. The list can also be ordered by places, documents (prescriptions, medical diagnosis record, brochures, etc), or and other entity types by choosing the appropriate tab.

After a few intermediate steps (not shown here), our user has narrowed down the search to information related to a specific visit to the doctor, as shown in Figure 3. She can now access related documents (such as brochures or prescriptions), connect to associated places (such as the hospital), link to associated people (such as the nurse) or play back desired portions of conversation.

Using the search toolbar in the upper right corner, the user can search within the current page (current context) for any information about yoga, which creates additional branches with yoga information.

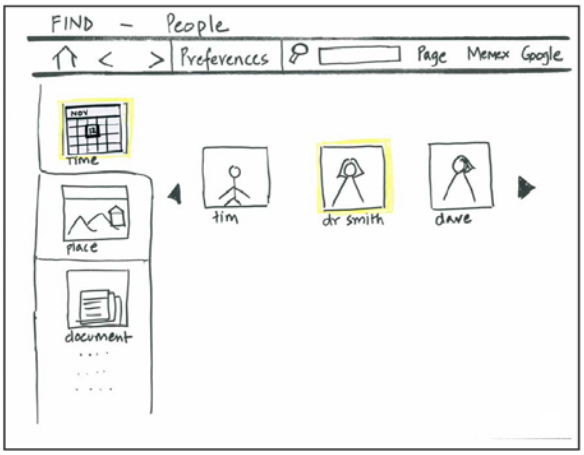

Figure 2 The 'Find-People' Screen

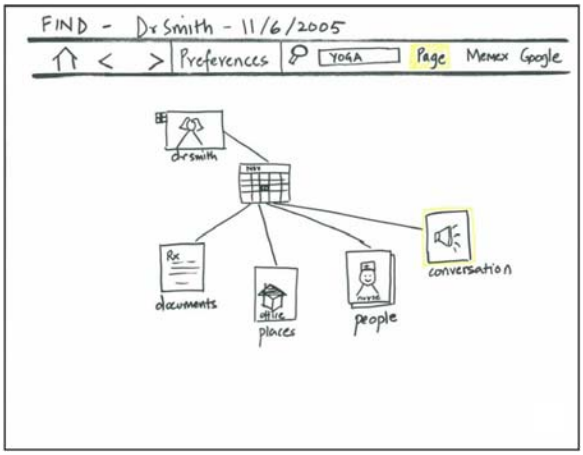

Figure 3 Information related to a doctor's visit on a specific date

4. DESIGN PRINCIPLES

We developed the following design principles as an outcome of the literature search and the suggestions by the experts.

- Maintain consistent, meaningful graphics [16].
- Support opportunistic navigation by bookmarking paths and previous searches [13, 16].
- Leverage user recognition rather than recall [13] by providing context for users while searching and browsing memories.

- Provide visibility for mode & system status to support situational awareness, provide visibility of current time and date whenever browsing, searching or scheduling in time [13, 16].
- Provide Internationalized Tool Tips for icons and buttons.
- Provide Help without losing state.
- Provide tutorials which explicitly demonstrate functionality.
- Since a disability can change over time or have a wide range of effects, support customization or adaptation of the interface.

Population-specific Results: MCI

- Simplify task steps.
- Provide views that can represent time and objects graphically.
- Provide time, space, and object reminders (for schedules, directions, medication).

Population-specific Results: Visual Impairment

- Provide enlargeable fonts & interface items (e.g. buttons).
- Provide contrast between font and background.
- Provide options for audio output: voice, speed, pitch.

5. CONCLUSION

The goal of this project was to consider the use of a personal memex by several populations, the high-functioning population, the population with MCI and individuals diagnosed with macular degeneration. By creating a customizable, adaptable set of preferences, which could be adjusted by the user or a caregiver, we might be able to support each unique population, while at the same time, providing the same universal design of the personal memex.

We interviewed domain experts, developed scenarios, and drew a low-fidelity prototype. We then went back to the experts with our prototype and conducted cognitive walkthroughs. The experts received our prototype enthusiastically and positively. To us, our design was validated when, midway through the walkthrough, one expert said, “This is cool! I want one of these!” [Karen Roberto, private communication].

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