Wearable Computing for Older Adults – Initial Insights into Head-Mounted Display Usage

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Abstract
With recent interest in industry, wearable computers with head-mounted displays are about to become mainstream. As it is typical for novel technologies, development is directed towards early adopters. This typically excludes special target groups such as older adults with age related special needs. However, it is necessary to consider their requirements when the technology matures, as they can benefit from wearable computing. In this paper we present an explorative, qualitative study with three older adults that used a wearable computer with a head mounted display during everyday activities. We derive requirements from the usage of existing applications, describe emerging usage patterns, highlight promising applications, and the reaction of the public.

Author Keywords
Head Mounted Display, Wearable Computing, Accessibility, Older Adults, Google Glass, Universal Design

ACM Classification Keywords
H.5.2 [Information Interfaces and Presentation]: User Interfaces Graphical User Interfaces

Figure 1: Participants during the study wearing used apparatus. We asked them for consent to include the photos without blurring their faces as this would have also blurred the apparatus.

Introduction

Through the recent interest by industry, wearable computers with head-mounted displays are about to hit the consumer market. Older adults are usually not considered when novel technologies are introduced as they are the typical not the early adopters [5]. However, wearable computing offers enormous potential for older adults beyond the use cases directed towards the whole population. Age related special needs can be addressed using digital devices. Yet, the specific requirements of older adults must be considered while developing the user interface, use cases, and application scenarios.

In this paper we describe the early insights about the usage of wearable computer with head-mounted display by older adults we gained from a user study. We conducted the study with the help of three participants that used a head mounted display during everyday activities for two days each. From semi-structured interviews and shadowing participants during device usage, we derive usage patterns and requirements as well as potential application scenarios.

Overview

We provided a wearable computer with head-mounted display to the participants and used three approaches to gain insights. We asked participants to perform a number of actions and observed their behavior. In addition, we conducted semi-structured interviews to explore their opinion about different aspects of the device. Finally, we shadowed them in the course of two days during their daily activities and accompanied two participants during a shopping tour. During all activities, participants' interactions with the system were automatically recorded by the wearable computer. Two female aged over 60 and over 80 years as well as one male subject aged over 80 years took part in the study.

For the wearable computer we used a Google Glass with a portable battery. As Glass can be charged while in use this ensured that the system was usable over a whole day. Glass was tethered to a Nexus 5 phone to provide network access and to help participants in case of problems utilizing a screencast from Glass to the phone.

At the beginning of the study we introduced the wearable computer and provided an overview about it's capabilities using the screencast to the Nexus 5 phone. After the introduction we asked participants to use the following actions: navigation through the live card interface, taking a picture/video, starting/stopping a stop watch and timer, reading the weather forecast, starting navigation, searching the internet, using the "WordLense" translate feature, retrieving a cooking recipe from "AllTheCooks". The participants select the task once with the touch interface on the side of Glass and a second time "hands-free" using "head wake up" (tilting the head back over 30 degrees) and voice command. Afterwards, the participants were asked to read text in different sizes and varying colors from the wearable display. After participants got familiar with the device by accessing its functionalities, we conducted a semi-structured interview. The following topics served as guidance throughout the interview: usability of the current hardware/functionality, potential improvements to the current design, future application scenarios. After the interviews, each participant used the device for 3 days (around 8 hours per day) during everyday activities. The activities included: house work, gardening, cooking, eating, relaxing, cleaning, and working in a wood workshop. In addition, we accompanied 2 participants while they went shopping in a larger German city for three hours each. After the 2 days

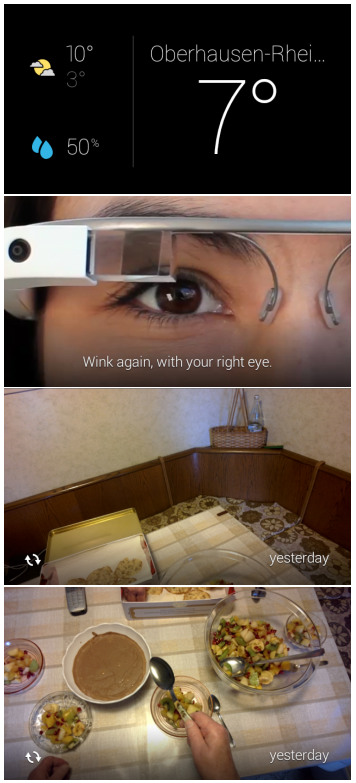

Figure 2: Screenshots from Glass. Top picture shows the weather forecast where the light grey font color is hard to read. The picture in the middle shows the instructions to the "wink for photo" feature that was also hard to read for the participants. Screenshots from taking pictures using Glass: The 3rd picture shows the first shot taken to high, next the last shows the scene the participant wanted to record.

of usage, we conducted another semi-structured interview discussing the experience of the participants, usability of the current system, current and future use cases and application scenarios.

Results

All participants mentioned that the current functionality of the device is limited. We assume reasons are in the English only menu and bad to no Internet connectivity during usage. Two of the participants live in a small village with bad mobile Internet coverage.

As all participants are used to wear glasses, they got easily accustomed to carry Glass. All confirmed that the head-mounted display was not hindering them performing everyday tasks. Only one participant voiced concerns as the device got unusually hot after a longer usage session of recording video and displaying directions.

All participants were able to read from the screen. During the simple reading test, all participants could read text of font sizes of 40px and higher on the 640 x 360 screen if a white font on a black background was used (best contrast). However, other font colors were problematic and needed larger sizes to be legible. Especially the light grey font color used by some standard Glass applications (see Figure 2) was hard to read for 2 participants.

Participants had difficulties to take the pictures they intended. Glass seems to be optimized for taking photos in a slight distance (e.g. taking tourist pictures). However, participants mostly wanted to take pictures to remember what they were doing (e.g. what things they had in the hand). It took a while for them to realize that the camera won't make a photo of what they see (depicted in Figure 2).

It was difficult for the two older participants to use the touch panel for navigating Glass. The activation tab and scrolling usually works, yet the cancel gesture ("swiping down") is more problematic and often not recognized. We assume this is due to fingers getting dry when getting older.

The active card display of Glass was intuitive for all participants. Yet, the two older users had difficulties to use some of the hierarchical menu structures (e.g. for settings and doing a video call).

Usage Patterns

All participants used the camera feature the most. A common use case was memory augmentation. Making pictures of things they don't want to forget. For example, taking a picture of medication, so they can remember that it was already taken or taking pictures of interesting items while shopping.

All participants preferred the "hands free" operations using the speech interface (although it was in English) compared to the touch interface during homework. Yet, being in town, participants switched to the touch interface.

During cooking and house work, the timer provided by Glass was appreciated by the female participants. However, it was difficult for them to set the timer using the current interface, as this involves a hierarchical menu.

Requirements

Although Glass was already designed with this in mind, it seems font size is not the only thing that matters. Contrast seems equally important, as participants found it very difficult to read the light grey fonts used in some of the screens provided by Glass.All participants request intuitive, "hands-free" interactions. The touch interface was difficult to use for the two older participants. A

Figure 3: A participant wearing Glass during wood work.

Figure 4: A participant using the timer application while cooking.

potential reason is that they are not used capacitive touch devices such as current smartphones.

Derived Application Scenarios
Short Term Memory Augmentation – As we described above, participants frequently took pictures to use them as reminder (e.g. taking medication). Using the time card interface of Glass, it was already easy to check if they performed the action or task in question by browsing through the taken pictures. Each picture has also a timestamp with it (see Figure 2).

Long Term Capture and Access – The participants saw potential in having a long term capture and access interface. Checking how and what they worked on/did a couple months or even years back. Search on specific activities (e.g. baking a apple cake) should be possible for access. Participants thought other types of indexing (e.g. location or time) would be not so useful.

Timer and Reminders – Although the interface was not optimal for them the users already found the timer application useful. They raised the need for several simultaneous timers and reminders.

Instructions – For the gardening, cooking and workshop scenario, the participants would like to get instructions (e.g. ingredient lists, work steps) for more complex tasks they do not perform often. They prefer the Glass display to paper or instruction manuals, as they don't want to clean their hands, stop what they do. Yet, they emphasized that the instructions need to be easily browsable.

Related Work

There is also a lot of work regarding user interface design for disabled and older adults, a good overview is given by Fisk et. al. [2, 1, 4]. Most work evaluating head-mounted displays use cases for older adults focuses on virtual reality [4].Today, wearable computers are mostly deployed in industrial applications [3, 5]. There have been similar studies for phones or tablets focusing on usage scenarios and interface design for an aging population [1].

Conclusions and Future Work

In this paper we conducted, to the best of our knowledge, the first assessment of wearable computers with head-mounted display with older adults. We identified a number of emerging usage patterns, derive first requirements, and identify potential applications. As the next step, we plan to develop an application for "short term" memory augmentation for the Glass platform, as this application had the highest importance for our participants and easy to do given the current system. We also aim to explore the hands-free interaction space using wearable computers with head-mounted displays with a special focus on older adults.

References

[1] Duh, H. B.-L. Senior-friendly technologies: interaction design for senior users. In *Proc. CHI EA* (2010).

[2] Fisk, A. D. *Designing for older adults: Principles and creative human factors approaches*. CRC press, 2012.

[3] Kunze, K. Does context matter?-a quantitative evaluation. *Pervasive Computing* (2009).

[4] Rebola, C. B., and Jones, B. Sympathetic devices: designing technologies for older adults. In *Proc. SIGDOC* (2013).

[5] Tanaka, K., Kunze, K., Iwata, M., and Kise, K. Memory specsan annotation system on google glass using document image retrieval. *Accepted as Adj. Ubicomp* (2014).