THE “VIRTUAL GUIDE DOG”
A SOFTWARE SYSTEM FOR MOBILE DEVICES THAT ENABLES COMMUNICATION, ORGANISATION AND MOBILITY FOR VISUALLY IMPAIRED PEOPLE

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Abstract: Mobile devices, like mobile phones or portable digital assistants, have become essential tools of modern IT consumers. Since they are growing more and more into full-scale computers (though definitely not full-size), we utilize these devices for aiding highly visually impaired people in their daily routine, particularly in their employment.

In this paper, we give details on a software system for mobile devices that integrates tools for organizing the daily work, communication by voice or text, and staying mobile using GPS information. All these tools can be accessed by vision-impaired people through colour-coded interfaces.

1. Motivation

Our research was initiated by the request of a big Austrian sports retailer, who employs vision-challenged people in its customer care department. Until recently, most requests from customers had to be handled by telephone, for which these people were excellently trained. With the increased importance of requests by e-mail and short message service (SMS), their vision deficiency threatened to turn them unemployed. The company wanted to know how these people could be enabled to fulfill other tasks in order that they could stay employed in the future.

2. Software Tools for Highly Vision-Impaired People

2.1. Usability of Standard Software and Hardware

The use of standard input and output devices of computers is rather limited for highly vision-impaired people. Mouse, keyboard, and monitor can only be used with specific additional aids:

- Using the mouse is very difficult, because the mouse pointer is very tricky to detect, even when it is considerably enlarged. Furthermore, frequently vision-impaired people track the mouse pointer out of the window boundary or lose it from their field of vision.
- The keyboard can generally serve as a good replacement for mouse input. However, in order to get oriented on a keyboard, some sort of marker(s) are necessary and the efficiency in general is rather low compared to a non-impaired person.
- The computer monitor, through its characteristic as a vision medium, constitutes the biggest hurdle for a vision-impaired user. There is no convenient way to “visualize” the content by other senses. For people with limited resolution capabilities, but an overall small impairment of the visual sense, enlarging the contents of the monitor display may help. As the last alternative, the monitor content can be presented by means of voice output, when this is appropriate. [Novak, 2000]

2.2. Why not just Use Speech Input and Output?

Our targeted audience is (highly) vision-impaired, but it is not completely blind! Only in the last three decades it has been detected, how much the visual performance of these people can be improved through continuous training, cf. [Zihl and Priglinger, 2002]. Without the stimulation of the remnants of the visual sense, the motivation is lost to rely on this sense. The visual sense is used increasingly less frequently and becomes atrophied.

To be able to get information via other channels than voice is also an essential aspect for enabling a person’s private sphere. To give an example, it might be quite embarrassing to check a buddy list of one's cell phone on a public bus and get all the
names spoken out loud. Similarly, sending and receiving short messaging service (SMS) mails necessitates communication channels that can be kept private.

Working environments also frequently inevitably contain noise disturbances. In our initial case, the first motivator to consider changing the working environment was triggered by the fact that the noise caused by the increasing number of employees in the customer service office (where the central telephone service is located) made the work almost impossible, despite using a headset.

2.3. Why not just Use Braille Devices?

For many completely blind people, the Braille device (cf. [DVBS, 2000]) is the standard tool for input and output at a computer. However, for our targeted audience, a Braille device cannot be used for several reasons:

- Many highly vision-impaired people additionally show a restricted senso-motoric behavior, particularly at their extremities. Thus, their fingertips are unable to feel the extruded Braille letters. One reason for this combination of deficiencies is that certain causes for vision-impairedness (like oxygen-deficit during birth or severe toxic reactions at a young age) lead to damages of specific brain sections that generally include, both, vision and senso-motoric control.
- Older people (whose job activities comprise heavy manual activities) show a sensitivity of their fingertips that is already too low for being trained on a Braille device.

Even if a Braille device can be used, when a person is not completely blind, the remaining visual ability must be trained in order to at least stay at its level; otherwise atrophies are unavoidable, as already mentioned.

3. A Desktop System Using Colour Codes

3.1. Visualisation Using Colour-coded Elements

After Intersport contacted our department, we developed a system of colour codes that enables the visualisation of digits and interaction commands (like OK, Cancel etc.) by means of coloured rectangles, cf. [Scott et al., 2002]. Fig. 1 shows a representation of the daytime (hours and minutes) using this colour-code scheme.

Our next step was to generalize our software for therapies of highly vision-impaired patients that frequently show multiple challenges, cf. [Priglinger, 2002]. Thus, it can be used for supporting rehabilitation (training of the remaining visus, hand-eye coordination, stimulating the use of the visual sense for daily activities etc.), but also as a prosthetics tool for better integration into the daily work process.

4. Transferring Our System onto Mobile Devices

4.1. Integrating the Desired Functionality into One Mobile Device

Particularly younger persons among the vision-impaired people want to gain access to modern media (internet, SMS/MMS, mobile communication in general). Interaction with these types of media solely by voice input and output is becoming increasingly impossible. It can be expected that these needs will quickly spread over all age groups.

We are, therefore, in the process of transferring our results onto off-the-shelf mobile devices (mobile phones, PDA, Tablet PCs) in order that the following essential improvements can be achieved for our target group [Mayr, 2003]:

1. organisation of the daily work independently from other people (Outlook-style calendar tool),
2. improved communication capabilities ("multimedia phone"),
3. improved mobility ("travel guide") for pedestrians via GPS.

4.2. Organisation Module

The organisation module comprises a calendar tool for planning the daily work that is in its basic functionality similar to MS Outlook (and will also synchronize with it), cf. Fig. 2. We found that challenged people which are re-integrated into the work process are frequently unable to handle the average amount of daily tasks, schedules etc., mainly because they lack routine. Therefore, using a calendar tool for organizing their work is especially important for challenged people.

4.3. Communication Module

The communication module (Fig. 3) comprises the ability to communicate on the basis of wireless services (voice, text, SMS/MMS, WAP/internet). An important feature is the management of contact lists (Phone numbers, addresses, buddy lists, internet URLs etc.). The vision-impaired user must be able to administrate her/his lists autonomously in order to keep her/his private sphere.

4.4. Mobility Module

This module serves as a GPS-based route planner and guide for pedestrians. It explains the route to the user (visually, e.g. by colour-coded arrows, and auditive) and monitors her/his progress continuously. The well defined user interface (see Fig. 4) makes it easy to follow the route and to find out the distance to the next route point. The visually impaired person gets information about the street she/he currently walks on and the next direction changes. If deviations are detected, corrections or alternatives are supplied.

5. Transition into a Commercial Product

Our software system has been designed for standard mobile devices and is continuously tested to be compatible with a wide range of such products. We use the Microsoft .NET framework for developing our application, in order to serve a broad variety of mobile devices, ranging from PDAs over (Microsoft-based) mobile phones to tablet PCs. The latter, for our use, have the advantage of a larger display up to letter size. The handling of miniaturized cell phones with “micro keys”, however, will be a separate challenge for the vision-impaired people.

For a mobile phone or PDA the costs for our system (including hardware and software) will be around € 500,- which makes it much more affordable than systems based upon custom-made hardware (starting at € 2,000,-). This factor enables nearly all of our targeted audience to get access to our system. Although still being developed, we continuously deliver product versions to pilot users (to get feedback on the usability of our system). A first version of our product will be delivered to a larger number of customers during autumn 2004.

6. Summary

Our “virtual guide dog” system, in contrast to systems designed solely for blind people, intentionally
trains the remaining visual sense of vision-impaired people. They continuously interact by means of colour codes using a touch screen on a desktop system or a mobile device. Additionally, our system enables these people to utilize the benefits of the modern information and communication society (mobile phones, internet etc.). Also the care effort for these people is considerably reduced, which not only saves costs, but also gives the people more personal freedom and intimacy.

Figure 4: PDA with Adapted GPS Receiver and GPS Navigation User Interface

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References


