Exploring Alternative Devices for Blind Users

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Abstract. The ability to take advantage of the information society is becoming a must for everyone. Computer literacy is becoming more and more important for individuals as well as corporations. Therefore no efforts must be spared to integrate everyone in this new and exciting development. If for non-disabled persons this can be a challenge, for certain types of disabilities the effort of adaptation is huge. In this paper we focus on blind users. One of the current alternatives for blind users is based on specific hardware that tends to be limited in features and expansibility or very expensive. The other alternative is PC based software. This latest option, although very powerful, has also several disadvantages, namely the lack of practical mobility. In this paper we present a new approach, the PalmPCs. PalmPCs are a cheap alternative compared to the hardware mentioned above, they are truly mobile, and they are widely available today. We argue that software can be written for these devices that satisfies the needs of the majority of the blind users. A small application for WindowsCE is presented in which the interface was specifically designed for blind users.

1. Introduction

This is the age of information. It is a common place to say that in a few years people who don't know how to use a computer will have the same problems as people who can't read now.

Therefore it is of the uppermost importance to cater for the computer needs of those who are disabled in some way. Otherwise those who suffer from certain disabilities will be put aside in this information revolution.

There are several types of disabilities that prevent people from using a standard computer. In this paper we will focus on the blind community, including people with severe vision problems.

People with special needs require special hardware. This premise is the basis for a number of special purpose devices that we're built for the blind community. In this paper we review the general features of the devices.

The other approach to people with special needs, namely the blind community, is to provide standard PCs with specific software in order to offer a more suitable interface.

In this paper we will show that there is at least one other option, which should be considered. This option can be used as a standalone device or in conjunction with existing devices.

We think that the time has come to explore a new type of devices and their usability by the blind community. Recently the palm computers have attracted a lot of attention for the general population. These devices have seen their processing power increased by at least one order of magnitude, with the amount of information storage also suffering an exponential increase. The latest releases have processors running at 200 plus Mhz therefore eliminating the lack of processing power problem. 32 MB of RAM is now a common feature for WindowsCE powered machines; furthermore RAM can be upgraded either internally or with the usage of memory cards.

We argue that these devices present a lot of advantages and that a suitable interface can be provided. Finally we shall present a small application that shows that using palm computers a suitable interface for blind people can be developed.

2. Special Purpose Devices

In general these devices can be classified as Note Takers, and Organizers. They offer common features such as

- Telephone Directory;
- Calendar and Diary;
- Calculator;
- Alarm;
- Text Editor.

Three types of input devices can be found on these devices:

- Voice recognition;
- Braille;
- QWERTY Keyboard.

Some of these devices, such as the Blazie Engineering Type'n Speak 2000 offer the three options whereas others offer just one type of input.

All these devices can be considered mobile with their weight varying between 200g and 400g. The measurements also fit the mobile category with the largest one having the dimensions of an A4 page with two centimetres of depth.

Some of these devices have appealing features, namely Internet capability. The devices from Artic Technologies, such as the Braille Desk 2000 or the TransType 2000 have a spell checker and the possibility to access on-line services by modem. The Blazie Engineering Braille n'Speak 2000 includes a Grade 2 Braille back-translator for print output.

The top range of these devices provides PC compatible operating systems to increase connectivity and/or sharing information. Some examples are the Robotron Pty Eureka A4 Professional, the T.F.i Engineering Inc. Myna Palmtop Organizer and the Pulse Data International BrailleNote.

The Eureka A4 Professional includes the DOSRead, a piece of software that enables it to access and manipulate files and sub-directories directly on MS-DOS 3.5 inch double-density diskettes. The Eureka A4 Professional has a word processor that uses Virtual Memory enabling users to operate large files.

The Myna Palmtop Organizer is a device compatible with IBM PCs running the MS DOS 5.0 operating system. It includes a screen reader optimised for the software included: WordPerfect, Lotus 1-2-3 and Dbase. This device uses Interlink software to share resources of other computers and can link into communications networks.

Finally the BrailleNote is a device that uses the last generation of Microsoft embedded operating systems: the Microsoft Windows CE. This device enables users to share word documents with the PC and provides access to the Internet with the included modem and email reader.

Despite the impressive list of features that were presented above there are some issues that should be taken into account. The price of these devices is one of these issues, since none of these devices can be considered cheap, with prices falling in the range from $1000 to $5000.

The main problem is due to the fact that these devices are only useful for a specific type of disabilities and therefore sales are restricted to that sector of the population.

Another problem lies within the mobility of the devices. Some of these devices, although mobile, can't be considered practical if one wants to take them everywhere. The weight and dimensions of some of these devices requires a case to be carried at all times.

However we believe that the main issue relates to expansibility. These devices either run proprietary systems, or use very specific processors that are not to be found in the mainstream computers. These implies that developing software for most of these devices is a costly operation with potentially little return considering that only people with this particular type of disability will be able to use them.

If one considers connecting the devices to a standard Windows, Mac or Linux computer then compatibility between formats becomes a real issue with very few device makers addressing this problem.

3. Standard PCs

All the three major operating systems have special software designed to allow people with vision disabilities to use a computer. The most common piece of software is the screen reader. Windows 2000 already incorporates a screen reader called Narrator, although unfortunately only in English. IBM has developed an Internet Browser that reads web pages but again only in English. Phillips introduced Free Speech, a product that will eventually eliminate the need for a keyboard. PCs certainly fulfil a lot of requirements and they processing power and storage abilities are more than enough for the vast majority of users.

Although the learning curve is steeper than for special purpose devices, PCs are more flexible, more powerful, and with the right software they certainly can do anything that a special purpose device does.

PCs are also pretty inexpensive when compared with special purpose devices, at least the desktop versions. However, desktop versions restrict mobility and that is a major issue. Why do people buy desktops as opposed to laptops or notebooks? There are three main reasons: performance, storage ability and price. However, in general, we believe that the first two reasons don't apply to the vast majority of the blind community. Performance is required normally due to the intensive tasks related to the visual interface, from 3D games to WYSIWYG interfaces, and fancy web plug-ins like flash, shockwave, and VRML amongst others. The storage ability of a PC is also used in a large percentage for visually related items like programs with highly graphical interfaces, to images and videos.

Portable PCs are more expensive and, as mentioned for the special purpose devices, are not practical for an every day life that includes outdoors.

4. The PalmPC Option

There are currently three major types of Palm PCs regarding their operating system: WindowsCE, PalmOS, and EPOC. From a hardware point of view, WindowsCE powered machines are probably the most powerful ones, providing processors that run faster than 200Mhz, with 32MB of storage, and sound input and output. Due to supremacy in hardware and mainly to the ability of sound I/O we will focus on the WindowsCE devices. However our comments are not operating system dependent.

As mentioned before, PalmPCs have reached a stage where the processing power is not an obstacle anymore. Storage capability can still be an issue; however with the decrease in price of flash cards and the possibility of connecting to a standard PC this issue can be resolved.

PalmPCs are also known as "display-challenged" devices. However, and considering the type of population we are focusing on, this is definitely not an issue.

PalmPCs offer an attractive set of features, namely:

- Internet connection: with the new standard arriving in 2001,2002, mobile phones can provide a feasible mobile Internet connection (even for people who don't suffer from visual disabilities). Some of the new prototypes of mobile phones even merge a PalmPC with a phone;
- Compatibility in formats with standard PCs: The formats are either compatible or there is a large array of options regarding converters;
- A wide range of applications besides the traditional organizer, plus text processing, spreadsheets, etc.

The price is usually lower than a standard desktop, and by consequence much cheaper than a portable PC or a special purpose device. As for the dimensions we are in the presence of a true mobile device that can fit in the pocket of a shirt or a jacket.

4.1. Text Input

Three types of text input are available in PalmPCs: handwriting, virtual keyboard, and sound. From these three options, the virtual keyboard should be dismissed due to its small size, making it difficult even for people who don't have visual disabilities.

Handwriting is definitively an option to consider. Blind people are able to write in plain paper therefore writing on a PalmPC is also worth considering. Furthermore, the problems, which arise from the lack of visual clues to provide continuity on plain paper, don't arise in a PalmPC because it is possible to write one character at a time. Going even further, audio feedback can be provided to keep the user from making mistakes.

Sound is probably the best option, however at the present time we are not aware of any freely available software for a PalmPC device that performs audio to text translation. The company Lernout and Hauspie has demonstrated a PALM with speech recognition showing that with processing power at current levels, there is no technological barrier to achieve this. Note however that speech recognition still has its problems; there are reports from Philips Free Speech users that say that they couldn’t get a reasonable recognition rate. Furthermore, speech recognition is language dependent and small countries with their own national languages will have to wait a long time before they have speech recognition. It’s worth pointing out that speech recognition is also environment dependent, i.e. it will be very difficult to perform speech recognition in a room full of people talking, or even on the street with all the noise.

Despite the fact that the software to perform audio to text translation is currently unavailable at large scale, it is worth pointing out that most PalmPCs with sound input have applications to record audio notes.

4.2. Command Input

Again, for command input, when speech recognition software becomes widely available this will no longer be an issue. As mentioned before, there are no technological issues from a

hardware point of view in developing such a piece of software. AutoPCs already have such software leading us to believe that in the near future some similar solution will be developed for PalmPCs. Nevertheless it is worth noting that speech recognition is still not a solution for all environments. As mentioned before, there are reports from users of Philips Free Speech that couldn't obtain a reasonable recognition rate.

For the present, the option for dealing with interface buttons and the alike is the pen interface. The relative position of the pen in the screen provides a clear clue of where the button is located.

Although not available at the moment for PalmPCs an audio feedback can also be provided in much the same way as with a mouse in a PC environment. An action is set when the mouse is up, which in a pen interface, can be interpreted as when the pen is up. This means that the user can travel with the pen down and get an audio feedback when the pen enters and exits a button. When the pen is released, the action relating to the button previously underneath the pen could be executed.

Blind users in standard PCs tend to use the keyboard tough. By using the TAB key they switch from button to button getting an audio feedback if a screen reader is present. In a PalmPC the same effect can be achieved by using one of the special keys usually available in many Palms, for instance the Cassiopeia from Casio.

The keyboard is the preferred input mechanism for obvious reasons: it is almost impossible to say where the mouse is located with your eyes closed. Note however, that with the pen interface there is always a sense of where the pen is located on the screen due to its small size.

When developing applications targeted for people with visual disabilities other forms of interface can be provided. In the AudioNotes section we will present an application that doesn't use the standard concept of buttons to provide an interface, instead it takes advantage of the fact that even blind users can tell where the pen is located in the screen.

4.3. Output

This is the biggest problem at the present time. In order for these devices to be user friendly they require audio output. General applications do not provide such output and this feature isn't incorporated in the operating system yet.

Unfortunately, there is no speech engine available freely or at a reasonable price that we are aware of at the time of writing this paper. However, the good news is that there are no technological issues regarding the development of this software.

Nevertheless there are no technological restrictions to build an application that provides audio output, for instance when the user is writing, the application can spell the written characters. In particular, it is extremely easy to provide audio output to commands, like pressing buttons. In the AudioNotes section we will present an application that provides audio output to commands.

5. AudioNotes, a small PalmPC application for blind users

The application developed is a small note reader. PalmPCs with audio I/O have an application called "Voice Recorder" that allows users to record voice memos at the touch of a button, even when the device is turned off. The application provided is targeted to blind users and to make it more explicit we've designed an interface without any graphical elements.

The application allows blind users to navigate between the notes, listen and even delete a note, using what we believe to be a user-friendly interface.

In general applications, blind users have to deal with navigation relying on the help of screen readers. The navigation on the interface can be achieved using a keyboard. However, navigation tends to get harder as the number of graphical elements increases. This approach can also be used with PalmPCs either using the special keys present in several PalmPCs, such as the Cassiopeia from Casio, or with an attached keyboard. Nevertheless, the natural interface for these devices is the pen interface. This is the interface that we'll explore in this paper.

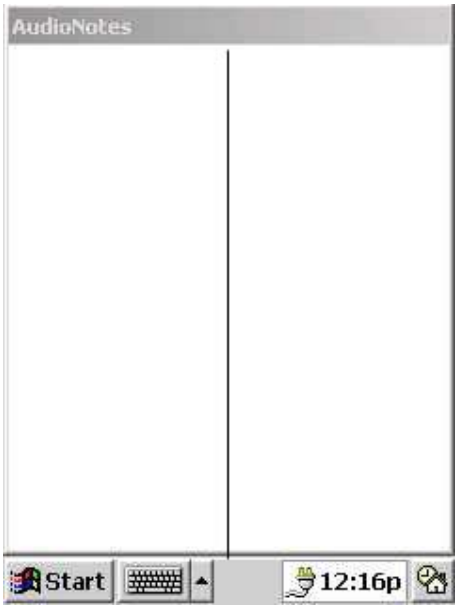

figure 1. Virtual Areas for AudioNotes

We consider are two types of pen input: clicks and pen motion. We also consider the combination of click followed by pen motion. Regarding clicks, the screen is divided in two virtual areas.

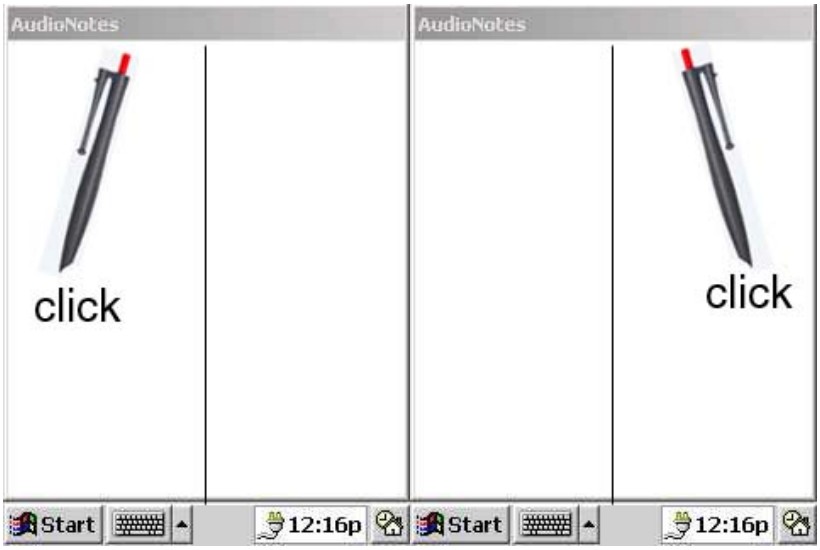

figure 2. from left to right: previous note; next note

The number of virtual areas is extremely important because the user must be able to find them without any visual clues; therefore we have only two areas. In AudioNotes the virtual areas defined are the left and right sides of the screen as shown in figure 1.

These two virtual areas provide some of the functionality required, namely: next note, previous note, first note and last note (see figure 2 and 3). Due to the large size of these areas, they should be easily found without any visual clues. Note that the vertical line is not present in the real interface. The fact that PalmPCs are handheld devices also helps the user to have an accurate sense of location of the pen on the screen without actually seeing the screen.

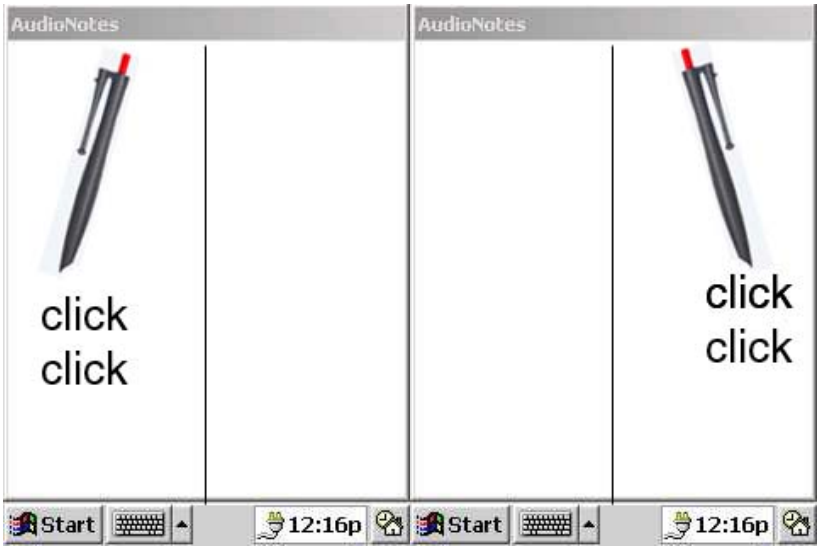

figure 3. From left to right: first note; last note

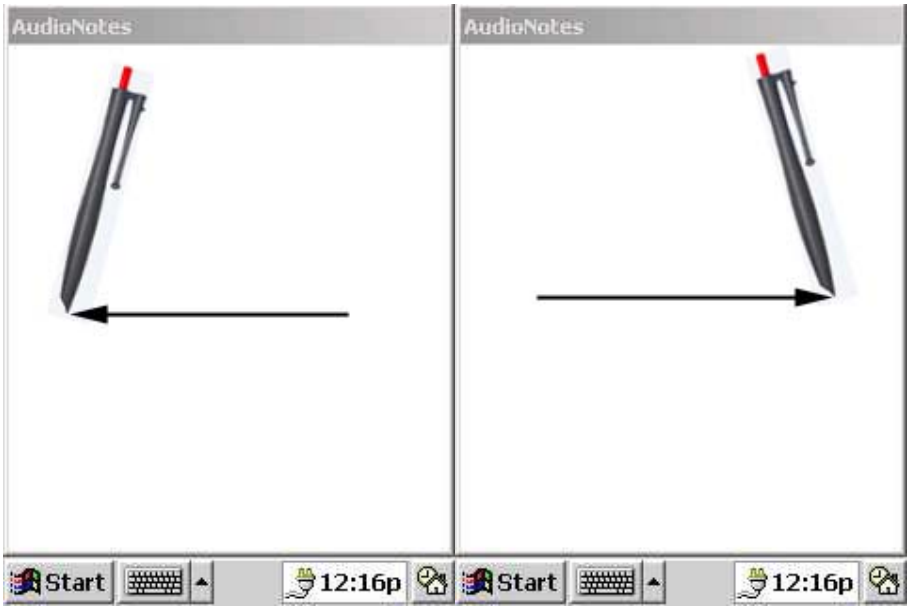

figure 4. Navigation within an audio note: backwards(left) and forwards(right).

Once a note is playing, the user can move back and forward within the note. These actions are done using pen movements. Moving forward is achieved by moving the pen from the left side to the right side, whereas moving backwards requires the opposite movement (see figure 4).

Volume can also be controlled in this application using vertical movements, for instance Volume up is a vertical movement up. These movements can start anywhere on the screen. Deletion of a note is also possible within the application. This is achieved combining both a click and a diagonal movement (see figure 5). The user is then prompted to confirm the action. This is done using an audio file with the corresponding text being: "Are you sure you want to delete this note? Press the left side of the screen to cancel or the right side to confirm".

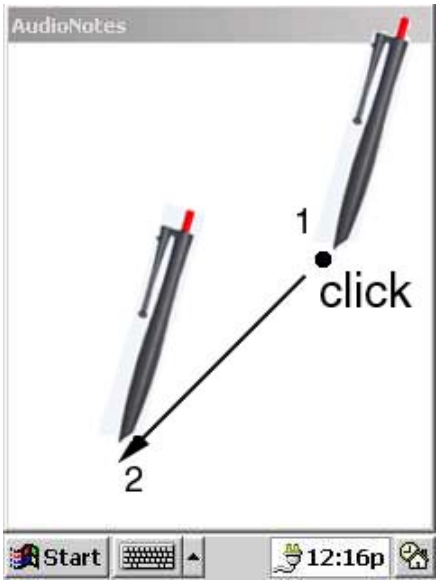

figure 5. Delete a note.

In this application every input from the user has an audio feedback. In this way the user always knows what actions are being performed.

Conclusions

The PalmPC has reached a stage where it can become a practical alternative to the current options described in this paper. Although there is still a need to develop software to make it more user friendly, we hope that in the near future this software will be made available. The AudioNotes application presented in this paper is an example of what can be done with a small effort from developers. The interface of this application shows that due to the features of the target population there is a possibility of exploring new types of interfaces, without resorting to standard buttons and other graphical elements.

The PalmPC option is here now, and when compared to the specific hardware devices or even to PC based solutions, it presents two main advantages: mobility and price. All that is required to make it user friendly to blind users is a small effort from software developers.

Acknowledgements

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