

# EVALUATION OF USER HABITS FOR CREATING AUDITORY REPRESENTATIONS OF DIFFERENT SOFTWARE APPLICATIONS FOR BLIND PERSONS

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## ABSTRACT

Blind and visually disabled persons use special software environments – such as Windows-Eyes, JAWS, screen-readers, text-to-speech programs – to access personal computers. These software solutions may offer sound samples for a better orientation. Besides speech, there are auditory icons, earcons or spearcons as possible extension of visual information. Finding the optimal mapping between (visual) events on the screen and their auditory representation is a difficult task. In the frame of the GUIB (Graphical User Interface for Blind Persons) project we started a survey for blind persons as well as for users with normal vision to investigate their user habits and needs, in order to find the most important software applications and sub-functions. Questionnaires were filled in and evaluated to determine the most important and popular applications to be extended with sound representations in the future.

## 1. INTRODUCTION

The GUIB project is about to ease the use of personal computers for blind persons. This includes the evaluation of different input media (mouse, Braille-keyboards) and output formats. The latest is based on auditory information, including spatial distribution of sound sources through headphone playback [1-4].

After many years of research, the Hungarian Institution of Blind Persons is involved in our survey. Our current investigation is about to find out how blind persons use personal computers nowadays, what are their likes and dislikes or their needs for a better accessibility. In order to do this we created a questionnaire to fill in both for blind people and for people with normal vision. Based on the answers we will select the 30-40 most important and frequently accessed programs and functions. Future works includes the selection of sound events (auditory icons, earcons or spearcons) representing these functions. These kinds of sound events are often used with or without visual content [5-8]. Finally, this would give the possibility for implementation in screen-readers or giving directions for further developments.

## 2. SOFTWARE USAGE OF EVERDAY USERS

First, we created a questionnaire for everyday users with normal vision. After consulting with the target group, a modified questionnaire was prepared for blind users. An easy-access MS Word version was created that can be downloaded and filled in electronically. Furthermore, there are special questions regarding benefits and drawbacks of screen-readers, JAWS or any other software they may use. There was also place for personal suggestions. Using the partnership with our partner university in Leipzig, Germany, we plan to collect the same amount of answers from both groups of users.

### 2.1. Subject Selection

The average age of the subjects was 27 years, mostly young adults. 10 females and 50 men participated, all with normal vision. They indicated themselves as “everyday users” or “slightly above average”. The evaluation was based on judging different applications and their functions by giving points from 1 to 5 according to Table 1.

Points	
1	Unknown by the user
2	Known, but no use
3	Not important, infrequent use
4	Important, frequent use
5	Very important, everyday use

Table 1: Ranking points for applications and services.

The most popular and widespread applications are ranked by giving individual points. We present here average values to show importance and user preferences.

### 2.2. Internet Access

As we expected, internet access is one of the most important tasks. The browser and the E-mail client got only 4 and 5 points. The most important features are:

1. Arrows back and forward (4,2 points)
2. Open/close new browser tab (3,9)
3. Typing URL address (3,85)
4. Open/close new browser window (3,8)
5. Save/open picture or link (3,6)
6. Home button (3,5)
7. Favorites, bookmarks (3,37)
8. Re-read/refresh actual site (3,35)
9. Print (3,32)
10. Find on this screen (3,2)
11. Stop downloading actual site (2,8)

People prefer to open new tabs instead of new browser windows (Internet Explorer 7 offers this). The use of the arrows and home buttons is very popular. Users rather type the URL address instead of taking it from the bookmarks. Printing directly from the browser window is not very important; users rather save the information and print them later if needed.

As part of internet usage the E-mail client also appeared to be very important. Its features were ranked as follows:

1. Delete mail (4,2)
2. Download new mails from server (4,19)
3. Compose new mail (4,18)
4. Send composed mail (4,18)
5. Reply (4,15)
6. Attach (3,7)
7. Forward mail (3,4)
8. Address book (3,37)
9. Reply all (3,1)
10. Save draft mail (3)
11. Print mail (3)

Results show that lots of users use Outlook or Outlook Express, where downloading and sending mails may need extra interaction (pressing buttons). Other clients (such as Thunderbird, Netscape mail) download mails automatically by opening the client. Furthermore, these programs use automatic save of drafts. Interesting is that printing mails and the need for accessing the address book is not so important. Users often keep one of the messages and reply to them in case of composing a new mail. Others just begin to type the recipients' name that is completed by the program automatically.

### 2.3. Navigation and File handling

We asked how important are certain services of a file manipulating application, such as My Computer (3,4), Windows Explorer (2,4) or a dedicated program e.g. Total Commander or the Windows Commander (4,25). People are very familiar with the latest, probably based on the routine with the Norton Commander under MS-DOS.

The most important features are:

1. Copy files (4,6)
2. Delete files (4,4)
3. Delete folder (4,25)
4. Make a folder (4,2)
5. Move files (4,1)
6. Rename files (4)

As expected, basic features are listed and judged to be very important. Although there are many other features, e.g. „sort by”, date, size, extension or other properties of a file, they are seldom accessed. This could be misleading because this information is often showed on the screen, they do not have to

be accessed directly. For an application for blind users there has to be an easy-access way to get this information as well.

As part of the file handling system, we have to take a look on the Recycle Bin as well. Open it (2,9) and reallocate already deleted files (2,8) are not frequently used. On the other hand, empty the recycle bin (3,5) seems to be a method to get more free disk space.

### 2.4. Document Handling

The Office package is well-known for everybody, and thus, these were graded high. The most important is Word (4,2) and Excel (3,7) followed by the Power Point presentation (2,8), the Notepad (2,4) and finally the Front Page (1,9). The MS Access seems to be unnecessary, 90% of the users do not know what this is.

The main features are:

1. Save file (4,3)
2. Open file (4,2)
3. New document (4,1)
4. Copy/paste/cut (4)
5. Save as (3,9)
6. Format text: italic, bold, underline (3,8)
7. Select/select all (3,7)
8. Print (3,7)
9. Fonts, Fontsize (3,6)
10. Repeat/undo last command (3,6)
11. Grammatical corrections, spelling (3,2)
12. Search/replace (3,2)

There is another important application, the Acrobat Reader as a widespread method to read PDF files. Most of the users gave 4 points, having an average of 3,8. All basic features appeared: open/close (3,8), print (3,5), save or save as (3,3) and at last the search function (3,2). As expected, people just need a tool to open and read PDF files and of course, print them. The portable document format is well received and there is the need to create them as well (unfortunately, Word for XP does not offer to save files in PDF format, one have to install the Acrobat instead of the Reader). On the other hand, lots of users do not know that there is a „find” function to browse and search through the PDF document.

### 2.5. Other Applications

There are other well-known applications under MS Windows. First of all, media content viewers, e.g. the Windows Media Player (3,7). However, the most popular player is Winamp (4) for audio, and the BSPlayer for video.

The evaluation of different messenger services showed that the Windows/MSN Messenger is the winning application (3,7) followed by Skype (2,6). On the other hand, ICQ (1,6) and chatting (2) are out of interests.

Downloading is part of the internet world. Download managers and accelerators (e.g. getRight) and DC clients are mostly used by the young, male adults (2,7 points each). Different torrent clients (3,1) are used most frequently.

Almost every user has the need for a virus/spam killer (4,1), but only in a very user-friendly way (automatic installation and maintaining).

Other important applications include: CD/DVD burning software (3,7), image viewer and handling (4) and ZIP/RAR compressors (3,3).

From the built-in services of Windows XP the following applications are frequently used: Printers (3,8), Control Panel (3,4), My documents folder (3,2), Paint (3,1), Search for files or folders (3). The command prompt (2,8), the calculator (2,7) and the Help (2,1) is only seldom accessed.

### 2.6. Gaming and Entertainment

Computer environments are based on visual information (GUIs). Especially in the gaming world, where almost all of the computer games use graphics and are therefore unable to play for blind users. Young people mostly play arcade and visually improved popular games, while older users prefer more simple games such as cards, chess or the games included in Windows XP. The communication with the blind community revealed the enormous need for gaming with sound only. This means, simple games without graphics that can be played audio-only. Furthermore, on-line gaming of board games, card games that could be accessed easily also by a blind man (e.g. on-line Poker games) would be interesting.

### 3. BLIND USERS AND INTRODUCTION TO SPEARCONS

Blind users use screen-readers and special computer environments. The most popular is JAWS (Job Access With Speech) that has to be purchased for money [9]. The newer versions of JAWS offer sound extensions as well, but this feature is seldom used. However, they told this to be important and good, so they look forward to extend and/or replace this sound data base. Spoken words by the screen-readers often restrict them, because it is too slow.

After the first introduction to the Hungarian spearcons, they found these very helpful. A MATLAB routine was used to compress original recordings of Hungarian words and expressions related to computer usage. Table 2 shows the spearcons (here translated in English), duration of original and compressed samples and the compress ratio. We tried different resolutions of original recordings from 8 bits to 16 bits and from 8000 Hz to 48000 Hz sampling frequency.

Spearcon	Duration (original) [sec]	Duration (compressed) [sec]	Compress ratio [%]
Close	0,87	0,302	65,3
Open	0,812	0,288	64,5
Save	0,687	0,257	62,6
Save as	1,125	0,362	67,8
Search	0,694	0,258	62,8
Copy	0,818	0,289	64,7
Move	0,748	0,272	63,6
Delete	0,661	0,25	62,2
Print	0,752	0,273	63,7
Download	0,853	0,298	65
Stop	0,908	0,311	65,8
Word	0,576	0,228	60,4
Word processor	1,14	0,366	67,9
Excel	0,599	0,234	60,9
Database	1	0,333	66,7
My Computer	0,805	0,286	64,5
Start Menu	0,734	0,268	63,5
Browser	0,845	0,296	65
E-Mail	0,545	0,22	59,6

Table 2. List of services and features for Hungarian spearcons introduced to blind users. The length and compress ratio is also shown. Original recording was made by a male speaker in 16 bit, 44100 Hz resolution using a Sennheiser ME62 microphone.

Spectral evaluation of the spearcons showed that 16 bits resolution and at least 22050 Hz of sampling frequency is required. Using 44100 Hz is recommended to avoid noisy spearcons.

Figure 1 shows frequency spectra of the word “print” in Hungarian. Compression has effect on the regions 4-5 kHz and at 16 kHz. The same effect appears using other spearcons.

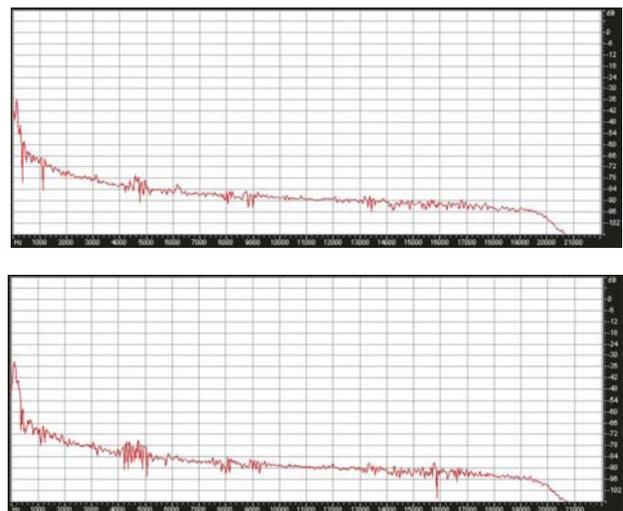


Figure 1. Spectral representation of the word “print” (in Hungarian). Original recording (top) and compressed spearcon (bottom) in 16 bits, 44100 Hz resolution.

Figure 2 shows frequency spectra of the same word in different resolutions. Decreasing of the sample frequency or resolution results in a noisy spectrum.

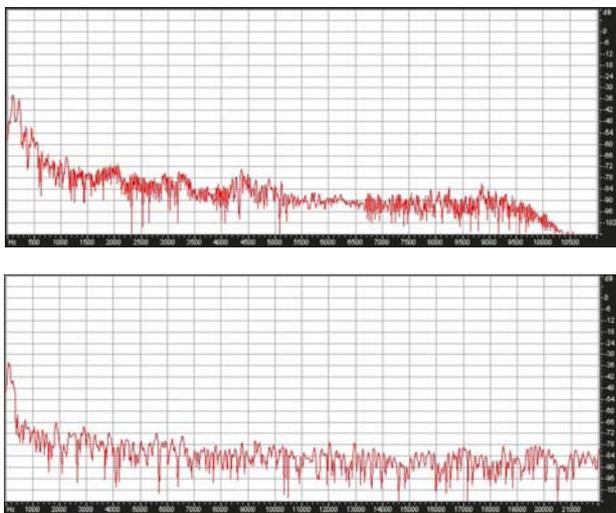


Figure 2. Spectral representation of the word "print" (in Hungarian). Compressed spearcon in 16 bits, 22050 Hz resolution (top) and in 8 bits, 44100 Hz resolution (bottom). Compare it with Figure 1.

A text-to-speech application (SpeakBoard) was also used to save wave files, but listeners preferred original recordings of a human speaker. The spectral representation shows low quality, limited bandwidth sample (Figure 3). Longer sentences (more than 3-4 words) become unintelligible after compression, so this method is not suited for creating spearcons longer than 1-2 words.

Sonification, as a method to make graphs or plots audible was also interesting for the blinds. However, they suggested to use this method rather for other purposes, e.g. for resizing windows, where increasing frequency corresponds to a "growing" window, while decreasing frequency represents "shrinking" window size.

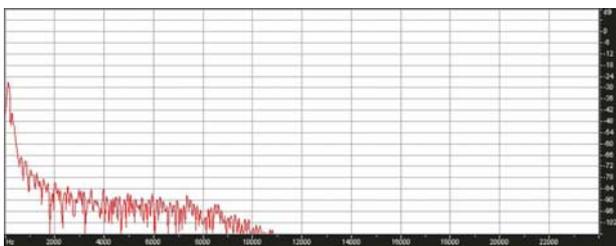


Figure 3. Spectral representation of the word "print" (in Hungarian). Compressed spearcon based on a text-to-speech application.

Compress ratio is almost linear from 59% to 68% as function of duration of the original sample: the longer the

sample the higher the compression (Figure 4.). It is always recommended to truncate the samples before compression to remove unnecessary silence at start.

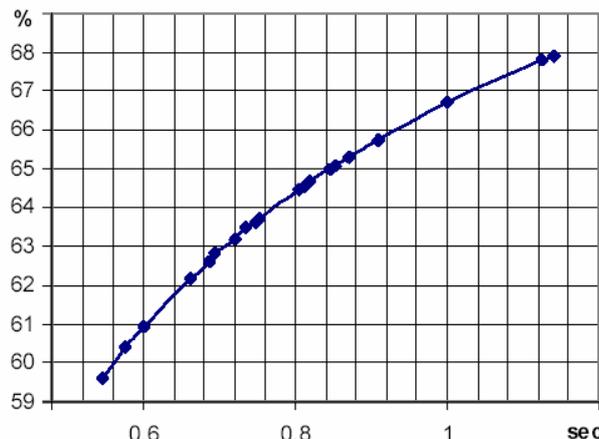


Figure 4. Compression rates (%) as function of duration of the original sample (sec).

#### 4. CONCLUSIONS

A detailed survey has been started to investigate user habits under MS Windows environment. 60 users with normal vision evaluated different applications and their functions. Meanwhile, an on-line, easy-access questionnaire is being filled in by blind users. The goal is to find the 30-40 most important feature that has to be represented by sound events (auditory icons, earcons, spearcons) as well. These can be then implemented under JAWS or maybe used for the GUIB project and for extended virtual simulation (spatial distribution with HRTF filtering etc.). Blind users support the creation of a collection of sounds and spearcons for a faster and better accessibility to personal computers. Future works include synthesis, recording and evaluation of different sound samples and spearcons.

#### 5. REFERENCES

- [1] Gy. Wersényi, "Localization in a HRTF-based Minimum Audible Angle Listening Test on a 2D Sound Screen for GUIB Applications," Audio Engineering Society (AES) Convention Preprint Paper, Nr.5902, Presented at the 115th Convention, New York, USA, 2003.
- [2] Gy. Wersényi, "What Virtual Audio Synthesis Could Do for Visually Disabled Humans in the New Era?" in *Proc. of the 12<sup>th</sup> AES Regional Convention*, Tokyo, Japan, June 2005, pp. 180-083.
- [3] Gy. Wersényi, "Simulation of small head-movements on a virtual audio display using headphone playback and HRTF synthesis," *Proc. of ICAD 2007*, Montréal, Canada, June 2007, 6 pages.
- [4] Gy. Wersényi, "On the improvement of virtual localization in vertical directions using HRTF synthesis and additional filtering," *Proc. of the 19<sup>th</sup> International*

*Congress on Acoustics (ICA07)*, Madrid, Spain, September 2007, 5 pages.

- [5] M. M. Blattner, D. A. Sumikawa and R. M. Greenberg, "Earcons and Icons: Their structure and common design principles," *Human-Computer Interaction*, vol. 4, pp. 11-44, 1989.
- [6] M. L. M. Vargas and S. Anderson, "Combining speech and earcons to assist menu navigation," *Proc. of ICAD 2003*, Boston, USA, June 2003.
- [7] B. N. Walker, A. Nance and J. Lindsay, "Spearcons: Speech-based earcons improve navigation performance in auditory menus," *Proc. of ICAD 2006*, London, UK, June 2006, pp. 63-68.
- [8] D. K. Palladino and B. N. Walker, "Learning rates for auditory menus enhanced with spearcons versus earcons," *Proc. of ICAD 2007*, Montréal, Canada, June 2007, 6 pages.
- [9] [http://www.freedomscientific.com/fs\\_products/software\\_jaws.asp](http://www.freedomscientific.com/fs_products/software_jaws.asp)