A Different Kind of IT (wanna be MacGyver?)

Kaido Kikkas
SPEAIT, Autumn 2023

What if...

- ...we couldn't see, so the display is useless?
- ...we had only one hand – or none?
- ...our fingers couldn't flex?
- ...we had so poor control of movement that even hitting the keyboard unit was difficult, more so for a specific key?
- … we lacked the muscle power to press keys?
- ACTUALLY, PEOPLE DO USE COMPUTERS DESPITE ALL THAT

Special vs regular

- A quite difficult choice:
  - A specialized device (e.g. a keyboard or a pointing device) could fit the person better
  - A regular device allows mobility and independence of the specific model. Also, it allows sharing the computer with regular users
- It helps to send descriptions of special use cases to producers of peripheral hardware

Visual impairments

- One of the two main targets of assistive technology
- Solutions can be sophisticated and expensive compared to some other groups of disabilities
- Three main categories – screen magnification, sound and tactile output (most commonly, Braille)
- Language specific
- Depends on operating system, hardware and stardards compliance of software

Screen reader

- Software that attempts to recognize screen output
- The results go (most commonly) to speech synth or Braille monitor/printer
- Mostly proprietary (JAWS is perhaps the most common), some open-source projects like Orca, Emacspeak and NVDA exist. Windows XP and newer have Narrator, OS X has VoiceOver, Android has Google Text-to-Speech
- Up to recently, expensive (in Estonia, the person has to pay 110€, old DOS version and new test version are free of charge)
- Support for Estonian language is still poor

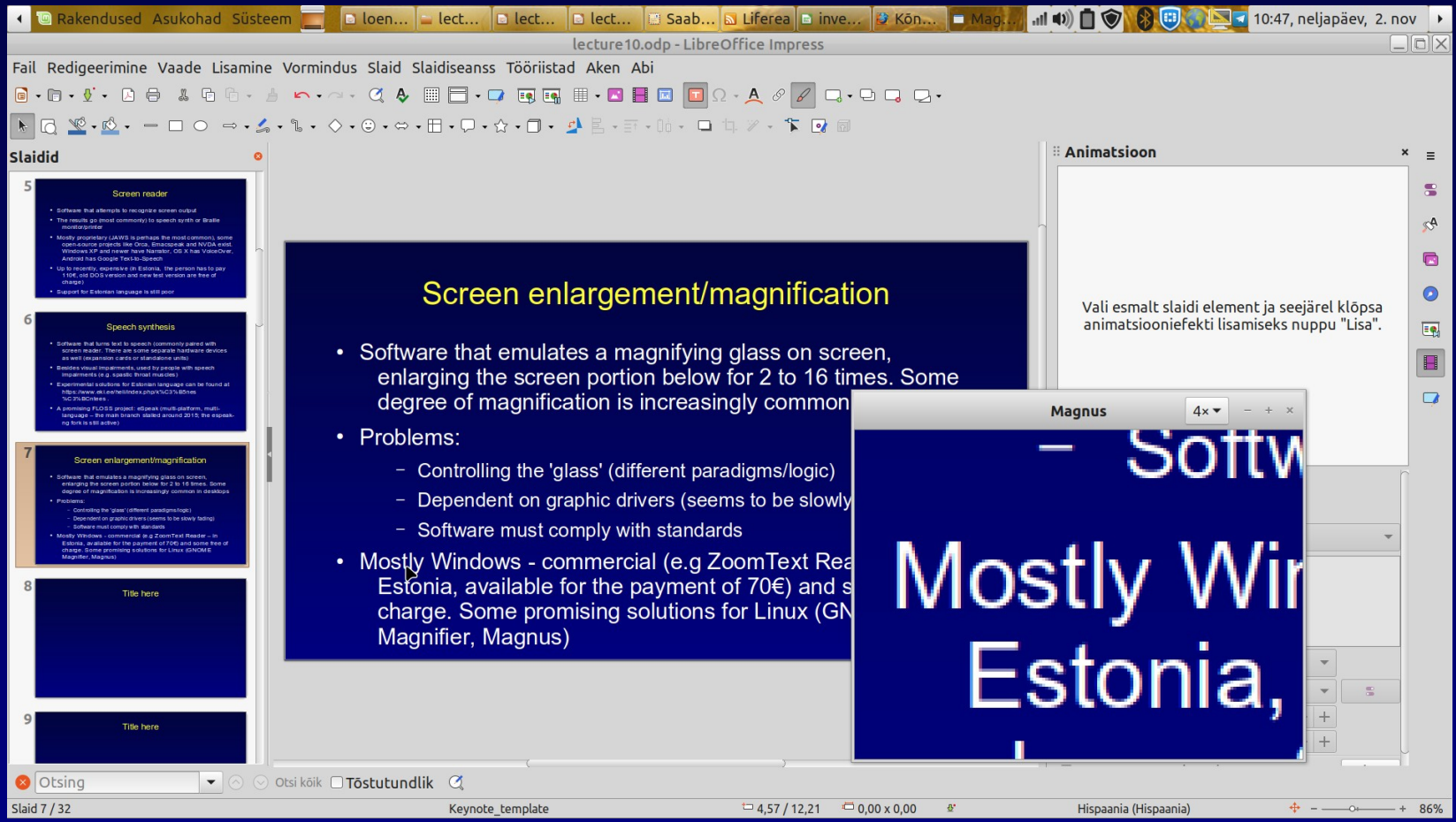
Speech synthesis

- Software that turns text to speech (commonly paired with screen reader. There are some separate hardware devices as well (expansion cards or standalone units)
- Besides visual impairments, used by people with speech impairments (e.g. spastic throat muscles)
- Experimental solutions for Estonian language can be found at https://www.eki.ee/heli/index.php/k%C3%B5nes%C3%BCntees .
- A promising FLOSS project: eSpeak (multi-platform, multi-language – the main branch stalled around 2015; the espeak-ng fork is still active)

Screen enlargement/magnification

- Software that emulates a magnifying glass on screen, enlarging the screen portion below for 2 to 16 times. Some degree of magnification is increasingly common in desktops
- Problems:
  - Controlling the 'glass' (different paradigms/logic)
  - Dependent on graphic drivers (seems to be slowly fading)
  - Software must comply with standards
- Mostly Windows - commercial (e.g ZoomText Reader – in Estonia, available for the payment of 70€) and some free of charge. Some promising solutions for Linux (GNOME Magnifier, Magnus)

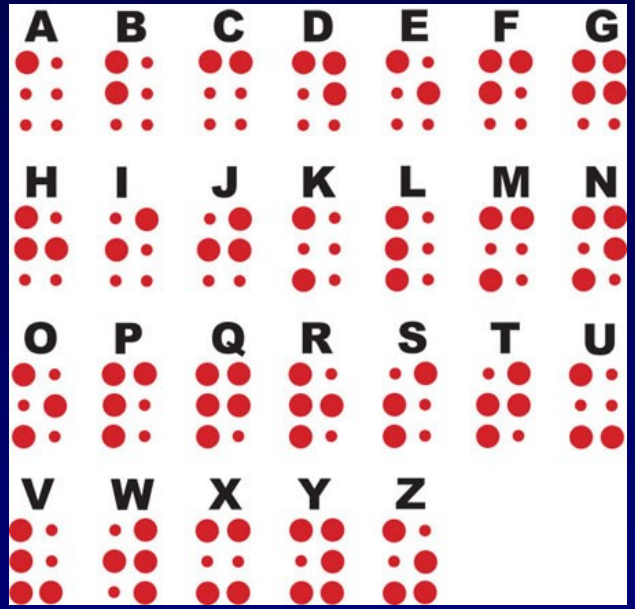
Example: Magnus in use



Braille display

- A device for dynamic presentation of Braille, using Braille elements with protruding knobs; the line can have 18-80 cells (characters)
- More expensive than voice output (in Estonia, the payment range from a couple of hundred to over 6000€), but is also more flexible (e.g. for programming)
- The main assistive solution for people with both visual and hearing impairment

Braille alphabet (English)



https://commons.wikimedia.org/wiki/File:Braille_alphabet.jpg

A Braille display

https://upload.wikimedia.org/wikipedia/commons/0/06/Refreshable_Braille_display.jpg

Braille embosser (printer)

- Device for Braille output
- Speed can reach 2000 characters per minute
- One- or two-sided
- Usually needs special paper (or plastic)
- Quite noisy
- Advanced models can also output simpler graphics (e.g. diagrams)

Example

Braille keyboard

- Chorded keyboard with 6 or 8 main keys (depending on the type of Braille used), plus some control keys
- Smaller than regular keyboard – quite mobile
- Many blind users stick with regular keyboards (sometimes, tactile stickers or voice feedback is used)

Example: Perkins SMART Brailler

https://upload.wikimedia.org/wikipedia/commons/d/d9/Perkins_SMART_brailler.jpg

Example: Braille In

Photo: Marcin Wichary, https://www.flickr.com/photos/mwichary/2251355897/

Tactile mouse

- Similar to regular mouse, but additionally gived tactile feedback via elements on the back of the mouse
- Still just prototypes (VirTouch VTPlayer was discontinued in 2009). Mostly Windows, but VTPlayer has a Linux driver available (from a volunteer at Sourceforge)

https://vtplayer.sourceforge.net/

Tactile PDAs

- Similar to netbooks or tablets
- Output via a hardware synth and/or Braille display, input via a regular or Braille keyboard
- Can be connected to regular computers
- Some are compatible with regular smart devices as well

RefreshaBraille 18 with an iPhone

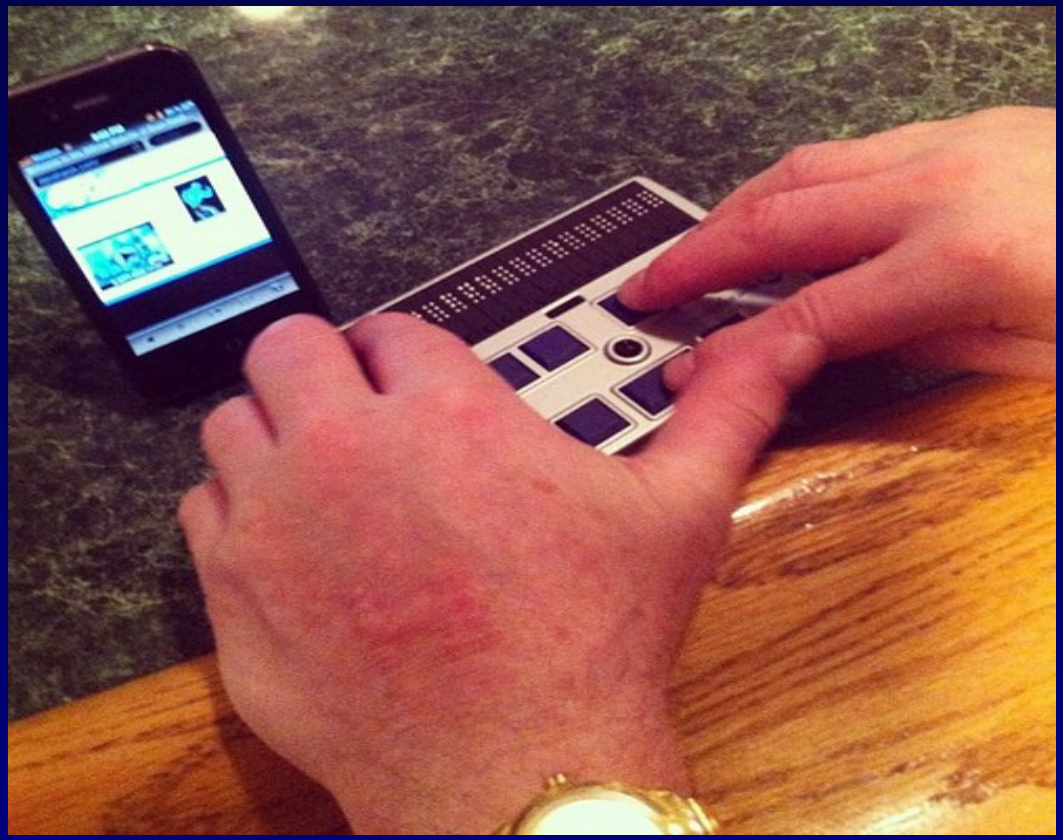


Photo: daveynin, https://www.flickr.com/photos/daveynin/6932301000/

Tactile e-readers

- Allow reading e-books in Braille
- Electroactive polymers (change physical shape when receiving electric signals)
- A prototype by Yanko Design

https://upload.wikimedia.org/wikipedia/en/thumb/8/80/Braille_e-book.jpg/220px-Braille_e-book.jpg

Note: the Web

- All the smart stuff above requires one thing: standards-compliance
- „It works with Chrome!“ is NOT a valid argument!
- The first step – W3C validator: https://validator.w3.org
- See also: https://www.w3.org/WAI/
- Useful: https://wave.webaim.org
- NB! There are significantly more blind people on the Web than usually assumed!

Mobility/motor/control impairments

- The second large target group of assistive IT. The problems can include
  - Hyperkinesis (spasticity) or hypokinesis (weakness)
  - Impaired coordination of movements
  - Dysfunctional or missing limbs
  - Problems with grasp
  - ...
- Mostly everything demanding fine motor control: inserting USB sticks or DVD-s, using mouse or keyboard etc etc

Some common issues

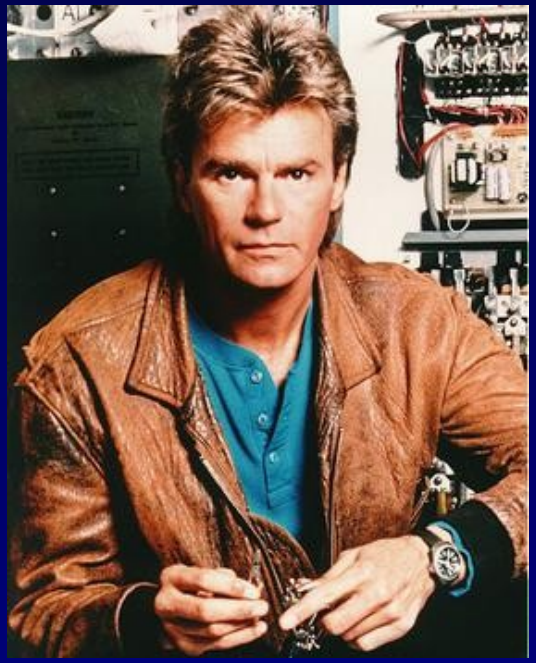
- Mouse - try with your non-dominant hand
- Connections (USB, HDMI, smart/memory/ID card, power cords...)
- Key combos
- Badly designed software (for quite a while, the Start menu introduced in Windows 95 tended to close on inaccurate movement, forcing the user to start over)

Solving it

- Hardware is often primary
- Software, while secondary, can still be vital
- A very wide choice of measures
- THE MAIN RULE: If a person retains control over just a single function, it can also be used to control the computer!
- THAT MEANS: no impairment prevents using computers!

Be MacGyver

- Special devices can cost tens of times more – but those may be not needed after all. Tweak the regular ones instead (MacGyver style)
- Simple techniques, e.g. a pen in a fist
- Put the keyboard where it works (e.g. at a foot)
- Mounts – special and regular (old desk lamp)
- Sticks for input
- Mouse vs trackball vs joystick
- Common tech with assistive use
  - Scanner with OCR
  - Webcam + sign language



https://en.wikipedia.org/wiki/MacGyver#/media/File:Macgyver.jpg

Example: Meelis ‘Mella’ Luks at work

Photo: https://www.mella.ee , used with permission.

Mouthstick

Photo: David Wallace, https://www.flickr.com/photos/dnwallace/2635909272/

Accessibility features in the OS

- First as a DOS complement (AccessDOS), later integrated into all common OS's
  - StickyKeys
  - RepeatKeys
  - SlowKeys
  - MouseKeys
- Onscreen keyboards (keyboard emulation)
- Keyguard

A keyguard (attached to a regular PC keyboard)

https://anthonyalleruzzo.weebly.com/computer-access-supports.html

Special input devices

- Membrane keyboard
- Mini- and maxikeyboards
- Chorded keyboards
- Other special keyboards
- Concept keyboards
- Touch display
- Foot mouse and other special pointing devices
- Speech input

Some examples

Photo: OregonDOT, https://www.flickr.com/photos/oregondot/6235420475/

Switches

- Not just for lamps...
- Simple hardware, needs software components for providing access
- Slow!
- Any controlled function can be used
- Can substitute both keyboard and mouse! (How many needed?)
- Onscreen keyboard
- Mouse switches

Examples

See also: https://en.wikipedia.org/wiki/Switch_access,
http://en.wikipedia.org/wiki/Assistive_technology

Sip-and-puff switch

- Input via breathing
- Single or double action
- Works well with simple signals
- The main use – Morse input
  (with text converter)

Photo: https://en.wikipedia.org/wiki/File:Sip-and-puff_device.jpg

Conclusion

- A huge field of challenges – and solutions
- Both special and regular (mix them)
- Hardware and software
- Highly individual
- An excellent way to become MacGyver – Swiss army knife and duct tape are fully optional :-)
- Can also be a suitable topic/area for hackathons etc

For further study

- MS: https://www.microsoft.com/en-us/accessibility/
- Apple. https://www.apple.com/accessibility/
- Ubuntu: https://help.ubuntu.com/community/Accessibility
- Android: https://developer.android.com/guide/topics/ui/accessibility
- Inclusive Technology: https://www.inclusive.co.uk

Thanks