# A different kind of IT

## (wanna be MacGyver?)

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# 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

# Regular or special

- 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

- 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 synth

- 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://phon.ioc.ee/dokuwiki/doku.php?id=start.et and http://heli.eki.ee/vaegnagijale/.

- A promising FLOSS project: eSpeak (multi-platform, multi-language)

# Screen 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'

  - Dependent on graphic drivers

  - Software must comply with standards

- Mostly Windows - commercial (e.g MAGic Pro – in Estonia, available for the payment of 70€) and some free of charge. Some promising solutions for Linux

# GNOME Magnifier on Ubuntu
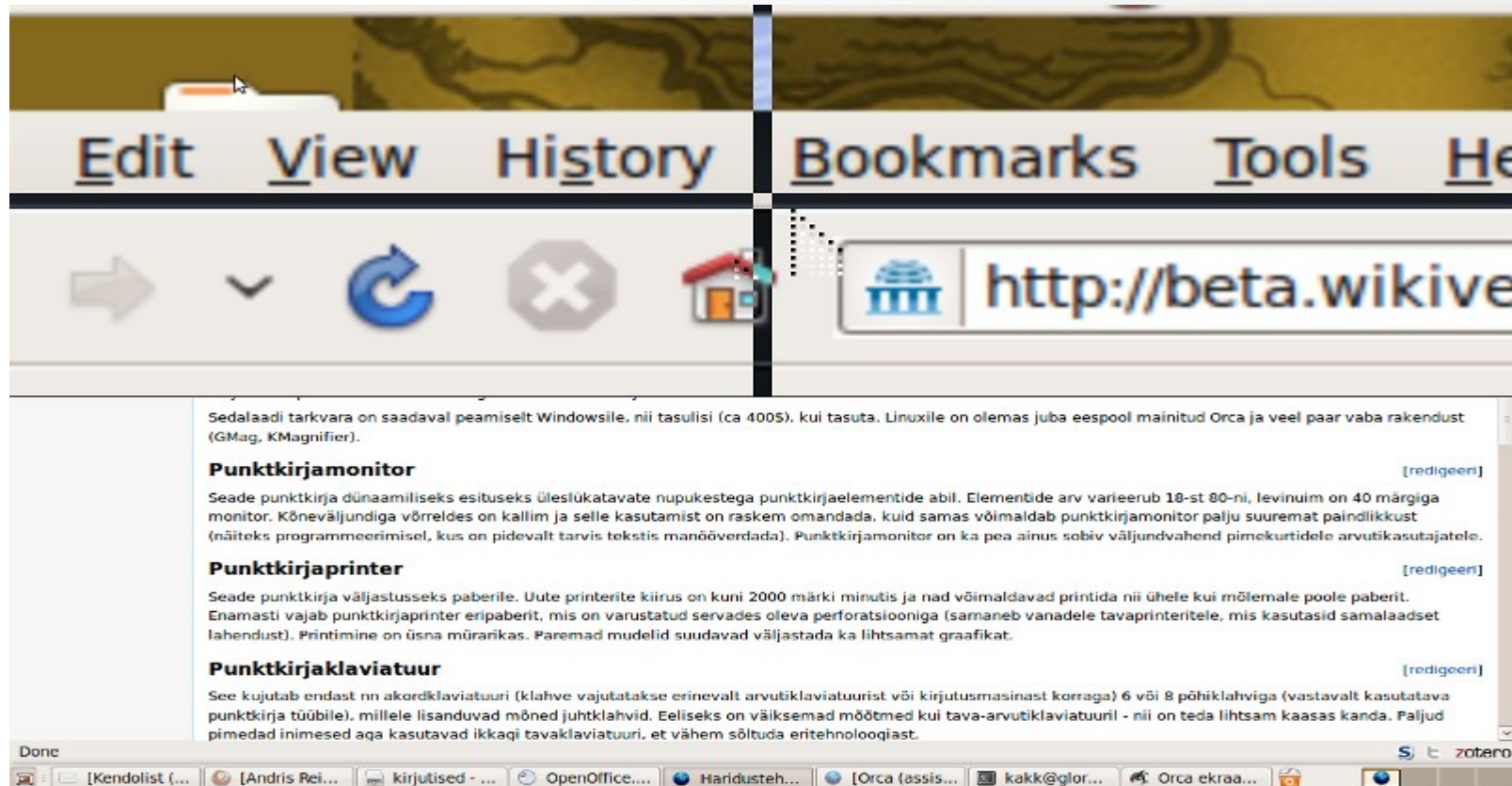
# Braille display

- 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 1000€), but is also more flexible (e.g. for programming)

- The main assistive solution for people with both visual and hearing impairment

# Braille alphabet
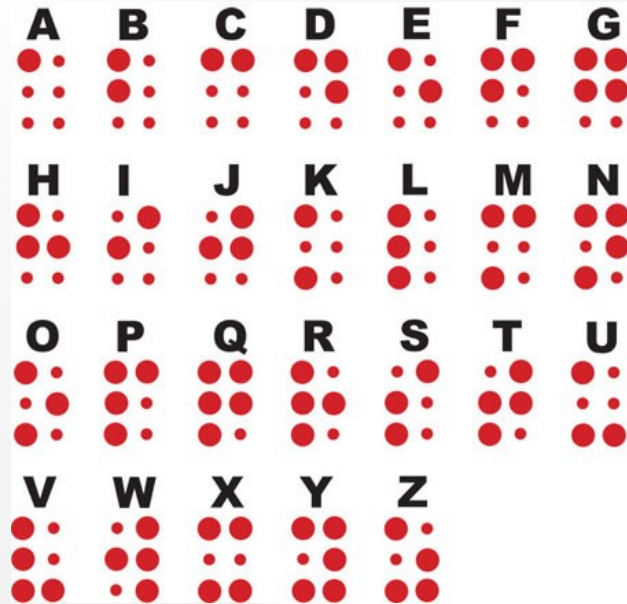


https://commons.wikimedia.org/wiki/File:Braille_alphabet.jpg

# 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)

- See https://www.viewplus.com/

# Braille keyboard

- Chorded keyboard with 6-8 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)

# Perkins SMART Brailler

# 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 had a Linux driver available (from a vo-lunteer at Sourceforge)

http://vtplayer.sourceforge.net/

# PDAs for blind people

- 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 mobile devices as well
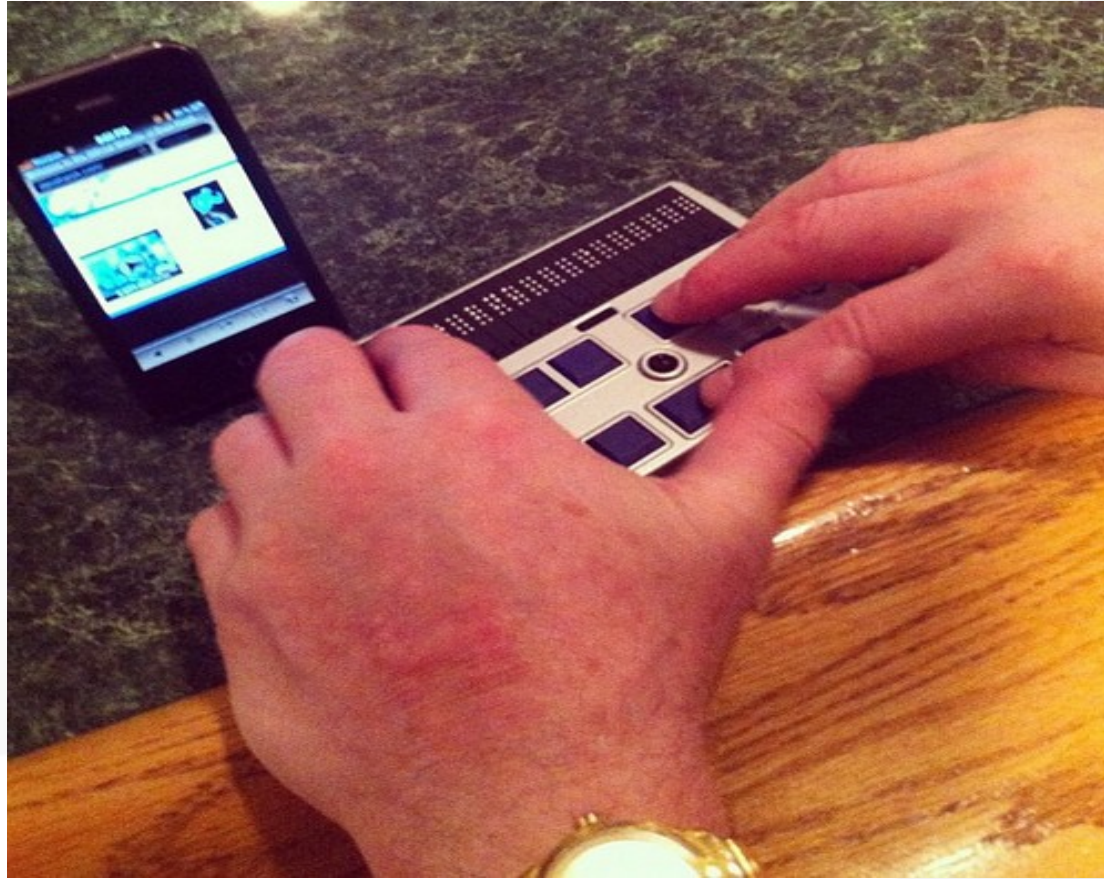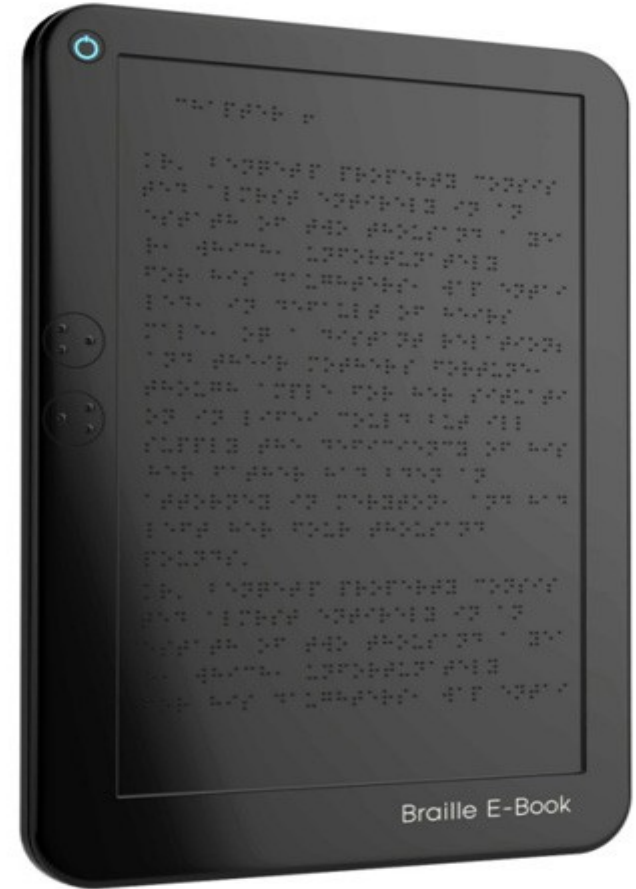
# RefreshaBraille 18 with an iPhone



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

# E-book 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

# Remark: the Web

- All the smart stuff above requires one thing: standards-compliance

- „It works with Explorer" 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/extension/

- NB! There are significantly more blind people on the Web than usually assumed!

# Mobility and control impairments: main challenges

- 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 problems

- Mouse  - try with your non-dominant hand

- Key combos

- Badly designed software

# 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: <u>no impairment</u>  prevents using computers!

# Regular devices

- Special devices can cost tens of times more

- Simple techniques, e.g. a pen in a fist

- Put the keyboard where it works (e.g. at a foot)

- Mounts – special and regular

- Sticks for input

- Mouse vs trackball vs joystick

- Scanner with OCR

- Webcam + sign language



Mr Meelis Luks, artist and IT guy (see mella.ee). Photo used with permission.

# Mouthstick



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

# OS accessibility features

- First as a DOS complement (AccessDOS), later integrated into all common OS's

- StickyKeys

- RepeatKeys

- SlowKeys

- MouseKeys

- Onscreen keyboards

- Keyguard

# Keyguard



http://www.inclusive.co.uk/Img/Dyn/Cache/Products/3742-200516105744-1514609478.jpg

# Special input devices

- Membrane keyboard

- Mini- and maxikeyboards

- Chorded keyboards

- Other special keyboards

- Concept keyboards

- Touch display

- Foot mouse and other special pointing devices
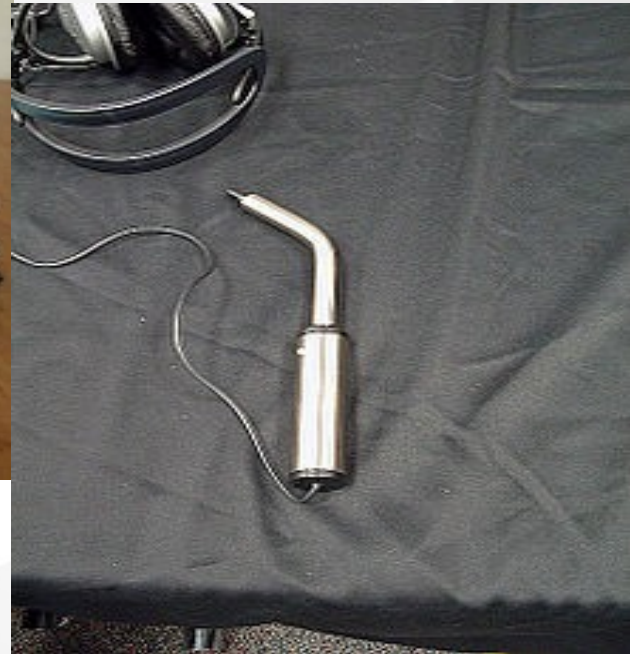
- Speech input

# 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!

- 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



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 :-)

# 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

- ...

# Thanks