This presentation was created for the Accessing Higher Ground conference November, 2014. It highlights the potential and reality of wearable computers and how they can improve accessibility.

Wearable Computers

photo: skin-pression by Clonny [https://www.flickr.com/photos/clonpop/54765165/](https://www.flickr.com/photos/clonpop/54765165/)

Mobile computers have become indispensable, the logical extension is to move the computing, sensors, and output away from a singular object and explore other options on the body.
Facial prostheses, 1919

Anna Coleman Ladd fashioned much-admired face masks for WWI soldiers in the European theater. Facial prosthetics and reconstructive surgery advanced significantly because of the war.

http://everybody.si.edu/technology/war
Pacemakers deliver small electric impulses to the heart to regulate heart beat rhythm.

- Introduced in 1958
- Remote monitoring
- Hackable

http://en.wikipedia.org/wiki/Artificial_cardiac_pacemaker

Obstacle Detection in 2004

The prototype WLVA consists of three major components: a head mounted display (HMD), backpack mounted equipment, and software. The HMD incorporates the scanning fiber display and optics mounted in a tube on one side of a spectacle frame, and a video camera with IR light emitting diodes mounted on the other side. The backpack-mounted equipment consists of a laptop computer, an embedded processor, and hardware to drive the scanning fiber display.
iGlasses have obstacle detection and vibrate when the user gets close to a low hanging branch or other object. [http://ambutech.com/iglasses](http://ambutech.com/iglasses)
photo: Google Glass by Lubomir Panak https://www.flickr.com/photos/drakh/9896425204/

Google patent on eye frame based obstacle detection http://www.google.co.in/patents/US3654477
Which of these kids is using an assistive technology device? Tablets, phones, and assorted mobile devices are so common that stigma associated with earlier devices has diminished.

photo: student iPad school by Brad Flickinger https://www.flickr.com/photos/56155476@N08/6660001925/
“What made the Rio and other devices so brain dead was that they were complicated. They had to do things like make playlists, because they weren’t integrated with the jukebox software on your computer. So by owning the iTunes software and the iPod device, that allowed us to make the computer and the device work together, and it allowed us to put the complexity in the right place.” -Steve Jobs

photo: Seele der Musikindustrie by ken fager https://www.flickr.com/photos/kenfagerdotcom/4398922649/
IPV6 allows every object to have its own IP address. Wearable devices can surround and work within your body and be uniquely defined. Lamprey inspired nano-robots are being developed that can migrate through your body for healthcare.


Photo: Pacific lamprey by USFWS Pacific https://www.flickr.com/photos/usfwpacific/7129322663/
Sensors
Vision

- MIT’s Media Lab has been innovating the vision-based computers for many years.
- Eye-based wearables follow the head and the user’s point of interest.
- Eye tracking allows hands free. Sensors are at head level instead of floor level (cane)

photo: http://cameraculture.media.mit.edu/
Hands free control is what makes wearable accessibility devices mainstream. Handsfree control works for drivers, people carrying objects, provides alternative gesture support, and helps those with physical disabilities.

http://www.usatoday.com/story/tech/2013/10/22/google-glass-aids-disabled/3006827/

photo: no hands by Jack Zalium https://www.flickr.com/photos/kaiban/6838891054/
The tilt control function is available on GitHub to integrate with other applications.
[github.com/kaze0/tiltcontrol](http://github.com/kaze0/tiltcontrol)  

This is just one example of using Glass and other devices to control the user’s environment and computers without their hands.

Watch for more work towards hands-free devices at [https://www.facebook.com/googleglassaccessibility](https://www.facebook.com/googleglassaccessibility)
http://amal.net/
• Ear based devices are common, especially after years of bluetooth headphones.
• Ears provide same benefits of eye-based location.
• Biometric information, such as body temp, pulse are available
• hands-free, display-free interactions
The Dash is a KickStarter funded project to create an ear-based device that provides hands-free/display-free support, biometrics, and audio enhancement. This is just an example of ear-based exploration. http://www.bragi.com/

Hearing based devices are display independent, a paradigm shift for designers.
Dialog is just one example of using biometric sensors for health monitoring. This watch and patch detect seizures, user feedback, and emergency alerting. [http://www.artefactgroup.com/content/work/dialog/](http://www.artefactgroup.com/content/work/dialog/)

Biometric tracking has become a key feature of most wearables.
Apple, Google, and Microsoft are creating platforms that allow the user to synchronize their various health monitoring devices, diet tracking, and medical health records

https://developers.google.com/fit/overview
http://apps.microsoft.com/windows/en-us/app/healthvault/728f1c88-7e2f-4b40-95c1-74fc09983689
Clothing can be embedded with threads that transmit electronic signals. A connected shirt can track movement, bio metrics, and potentially gestures. This is great for health monitoring. [http://www.omsignal.com/](http://www.omsignal.com/)

Clothing can also be combined with sensory output, such as vibrations, to give the wearer feedback.
This jacket gives vibrational feedback to let the user know if they should turn left or right while walking.
http://wearableexperiments.com/navigate/
Applying vibrations to the feet can provide enough stimulation to trigger a threshold within individuals with limited sense of touch. This could prevent falling.

http://spectrum.ieee.org/tech-talk/biomedical/devices/vibrating-shoes-restore-balance-for-seniors

Prosthetics are no longer static extensions of the body. They contain multiple sensors, processors, and controllers. DARPA has been encouraging prosthetic and exoskeleton designs. [http://science.howstuffworks.com/prosthetic-limb4.htm](http://science.howstuffworks.com/prosthetic-limb4.htm)

the DEKA arm is a good example of complex, computerized prosthetics. It was sponsored by DARPA http://www.dekaresearch.com/deka_arm.shtml
Detecting the person’s motion for gesture recognition, detecting their tasks, understanding the difference between a sit up and a push up, hands-free. Lars Asplund, Professor Emeritus in Robotics at MDH, is working on this hand-based device http://phys.org/news/2014-05-virtual-keyboard-reality-video.html#nRlv.
Memory smart watches could help those with memory loss via geolocation/geofencing, reminders, providing information to rescue
photo: No, I’m sorry, I don’t know who you are by Neil Moralee https://www.flickr.com/photos/neilmoralee/8268874659/
Short Term Memory Loss

People with short term memory loss require reminders. The watch is a natural location for reminders. Motion and biometric sensors could also detect when an activity has been accomplished. This avoids reminding user to do an already completed task and encourages independence.

shown watch: http://www.appsapk.com/calendar-reminder-smart-extras/
Sension is working on facial and gesture recognition with Google Glass

**Facial Expressions**

Sension builds on the state of the art in face tracking to locate 76 landmarks in a user’s face.

Sension machine learns what it means to be engaged across the internal shape parameters of the face, giving us super accurate user engagement scores and analytical insights into the content users are interacting with in real-time

http://www.sension.co/case
WearScript from Open Shades uses Mechanical Turk and VizWiz to allow blind users to identify text and objects. http://www.openshades.com/
Text translation has also been integrated by Word Lens. http://questvisual.com/us/
Apple Pay allows user to make payments with minimal movements
Remote microphone for voice dictation, actions
https://www.apple.com/apple-pay/
Captioning on Glass allows a person with a hearing impairment to see what another person is saying. This Georgia Tech project is available as open source. [http://borg.cc.gatech.edu/ccg/?q=projects/cog](http://borg.cc.gatech.edu/ccg/?q=projects/cog)

Google also has a patent on speech to text transcription [http://goo.gl/p9IEIq](http://goo.gl/p9IEIq)

The finger reader project from MIT uses a finger based device to track the sentence a user is reading and convert to speech. It also guides the person to move up/down if they go off the line. http://fluid.media.mit.edu/projects/fingerreader
This should be possible with an eye-based device.
An intuitive portable device with a smart camera mounted on the frames of your eyeglasses, OrCam harnesses the power of Artificial Vision to assist the visually impaired. OrCam recognizes text and products, and speaks to you through a bone-conduction earpiece. http://www.orcam.com/
Force-Sensing Switches

- Replace joysticks and buttons with wearable switches that detect pressure change
- Embed within shoes and gloves

http://apps.research.ufl.edu/otl/pdf/marketing/13041.pdf
Apple just released the developer kit for Apple Watch. I haven’t found the documentation on accessibility, but we would expect it to offer voiceover. Apple Watch, like Google Wear, depends on a phone and the experience is an extension of the phone’s app.

http://www.android.com/wear/
Tweet: https://twitter.com/ilkapirttimaa/status/535384474025197568
The intellect of the wise is like glass; it admits the light of heaven and reflects it.

-Augustus Hare

http://www.brainyquote.com/quotes/keywords/glass.html#MkmtKupHAEVv7W3f99

The opportunity exists for us to build devices that express our hidden selves, explore the world with new senses, and combine reactors and reactions. What could you solve with wearable computing?
Resources

• Quick Survey
  • Survey Monkey: SurveyMonkey.com/s/YHBDNJ7

• Ted Drake
  • Twitter: @ted_drake
  • Web: Last-Child.com
  • SlideShare.net/7mary4

• WearAbility
  • Twitter: @wearabilityorg
  • Web: WearAbility.org

http://twitter.com/ted_drake
http://last-child.com
http://slideshare.net/7mary4
http://twitter.com/wearabilityorg
http://wearability.org