

sonification + interaction

in wearable technologies + e-fashion



PROF. KIRSTY BEILHARZ

examples + motivations

- experimental use and user evaluation of recent technologies integrated into worn garments or devices (as distinct from mobile or handheld devices)
- *what changes* when technologies available in a mobile phone (e.g. location services, GPS, motion sensing, WiFi + Bluetooth comm.s, sound sensing, display of sound and vision) are *worn* on the body, *integrated* in clothing + wearables?
- *what different technologies* are suited to wearing?



folding display

Kirsty Beilharz, Andrew Vande Moere & Monika Hoinkis

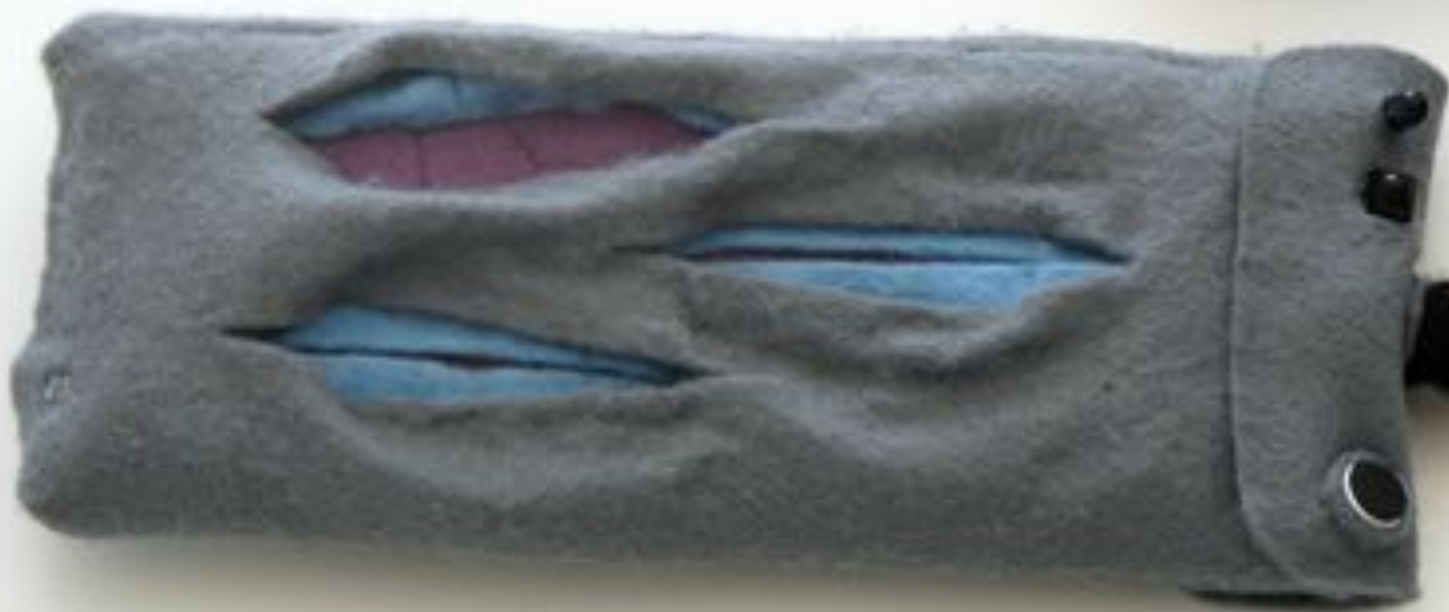
Iteration 1 - felt pouch revealing coloured slits in response to motion.

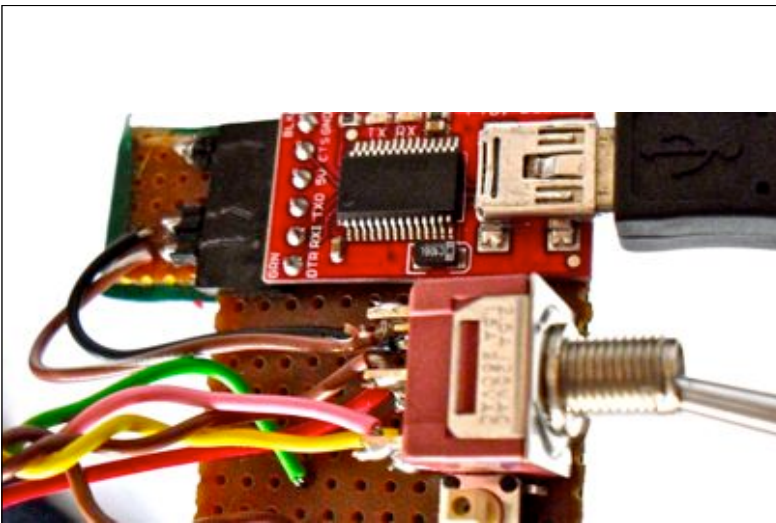
Photo by Monika Hoinkis.

Physical Visualisation and the Folding Metaphor

The wearable visualisation and sonification display represents live sensor-based information (processed against cumulative time-based calculations) to the wearer and people in her/his immediate vicinity, with the aim of augmenting social interaction and interplay.

<http://www.sense-aware.com/2010/06/expressive-wearable-sonification.html>





'Internals' of folding display control boards, sensors, and muscle wire activation.



Iteration 2 - integrated power, sensors and analog visualisation.

Photo by Kirsty Beilharz.

Technical Execution

The sensing part of the wearable expression captures ambient noise levels and executes a time-based concatenation using a small microphone; a light sensor whose purpose is to distinguish between an indoor or outdoor environment; and multi-dimensional gyroscopic sensor to capture movement information. The programming side was used to examine this data as a factor of time, e.g. amount of activity and whether that represents an increase or decrease, whether sustained or momentary, and comparative ambient noise levels. Parts: Soundgin synthesiser, 5V sensors, Arduino microprocessor and Processing programming environment, with a custom board that operated the controllers and output). Output: sound speaker and moving fabric slits revealing different mounts of underlying colour. controlled by muscle wire (extremely fine conductive thread that contracts when charged with electrical current).



wearable bio-sensors transmitting by WiFi
Jerry Nugroho & Kirsty Beilharz

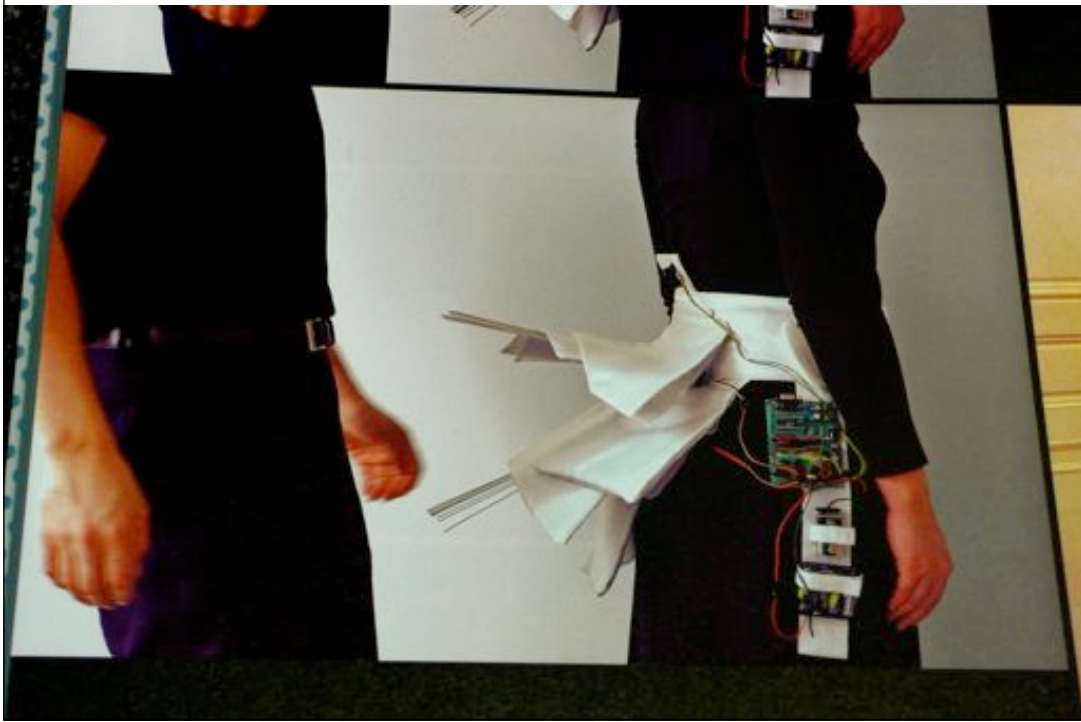
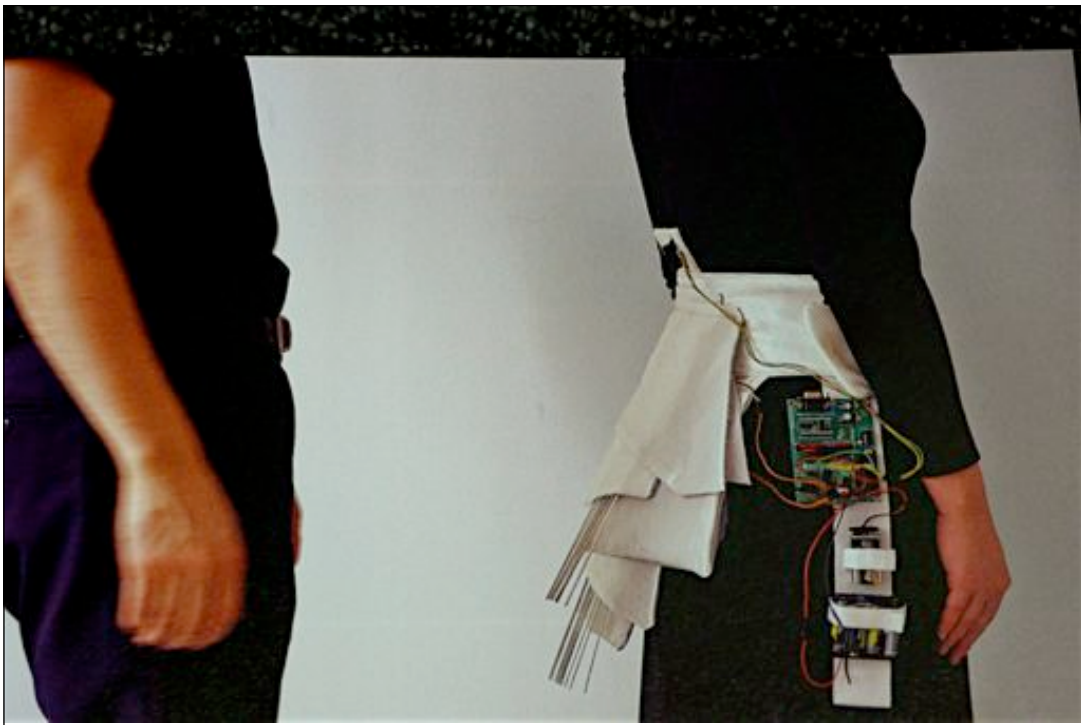
electroluminescent basketball jersey
visualisation for augmenting team sports
Mitchell Page & Andrew Vande Moere

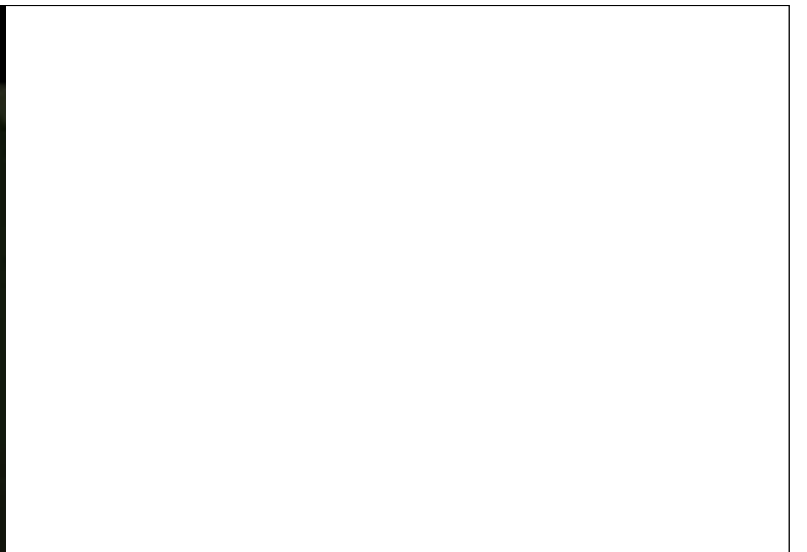


<http://web.arch.usyd.edu.au/~andrew/publications/pervasive07.pdf>



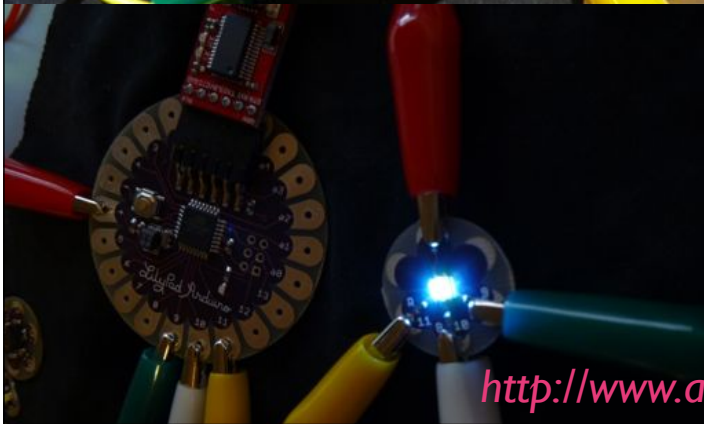
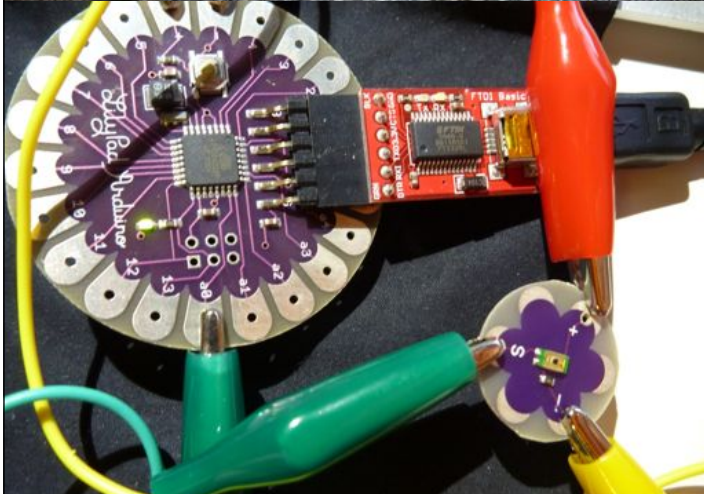
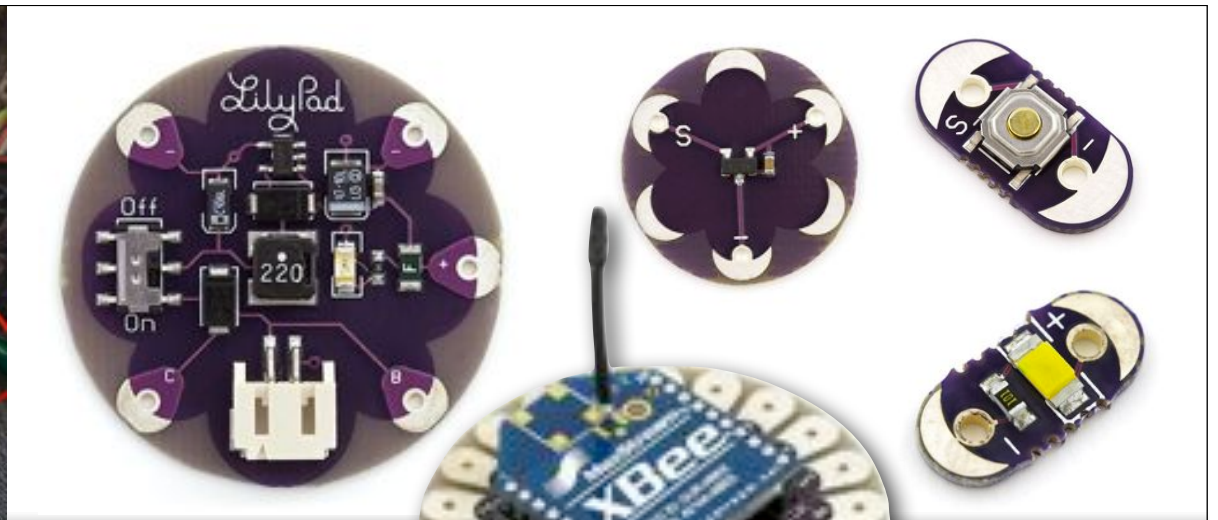






galvanic skin sensing - conductivity indicating stress, anxiety





<http://www.arduino.cc/en/Main/ArduinoBoardLilyPad>



<http://www.eclipsesolargear.com>



<http://planetgreen.discovery.com/sweepstakes/solar-backpack/>



<http://www.noonstyle.com/index.php#solar>



http://www.treehugger.com/files/2005/10/solar_powered_p_1.php



MP3 Products

Performance optics are integrated with state-of-the-art electronics to free you from wires and fuel your training session with the music that moves you.

Bluetooth® Products

The absolute freedom of wireless communication and music is combined with the patented optics of performance eyewear.

<http://au.oakley.com/customer-care/support/electronics>

why are some wearable technologies popular & others not?



Nike+ SportBand

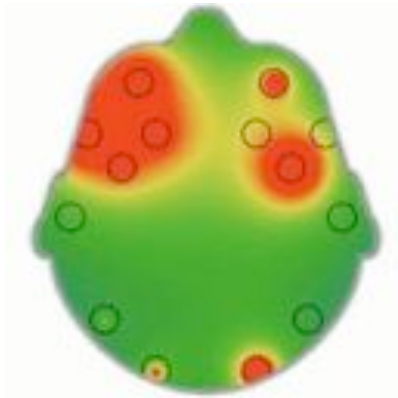
Don't run with music? With the Nike+ SportBand see your pace, distance, time and calories burned.



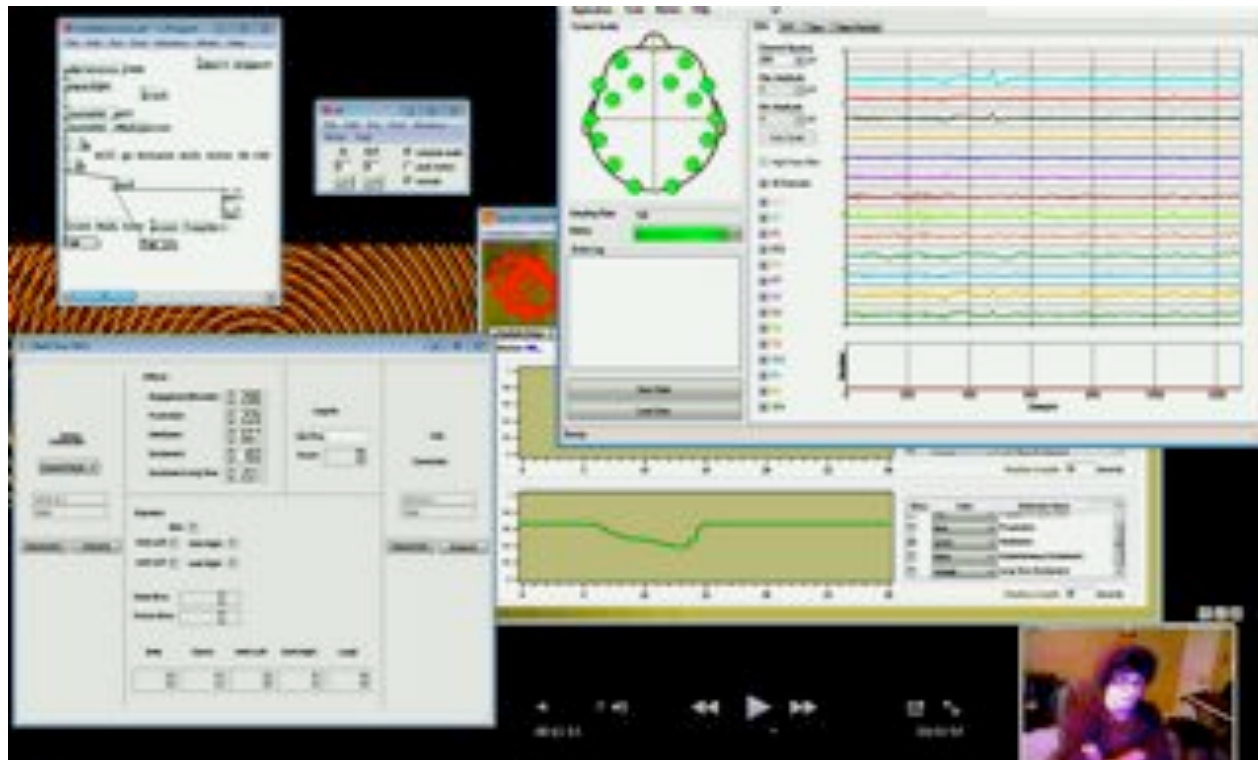
+



wearable technologies
that have potential for
integration in clothing



Here is a picture feeding into Pure Data by 'quantum.Trip' <http://vimeo.com/13047029> and MindYourOwnOSC, distributed on <http://sourceforge.net/projects/mindyouroscs/> open source software. You can see the live tracking in action. (photos from *EPOC website*)



We are using the Epoch headset EEG live data feed as the source for sonification of brain activity and to try to distill useful information from the most active and dynamic brain regions, to overcome the intrinsic orthogonality of the feeds.

IMAGINE THESE NEW VIEWING EXPERIENCES

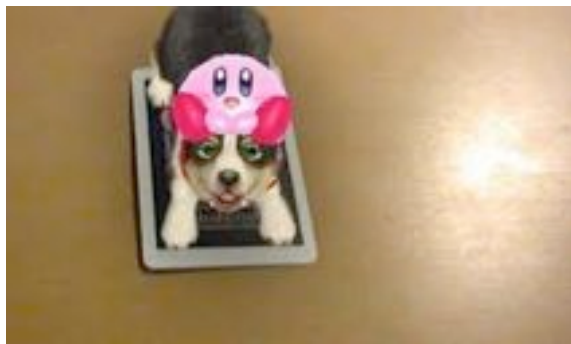
- *Giving a speech while information is streamed to your eyeglasses in real time*
- *Presenting to a crowd with your notes secretly stowed away in your eye glasses*
- *Extending your everyday computing environment to include your eyewear display*
- *Walking down the street, seeing your favourite friends show up "on screen" 2 blocks and 1 cafe away*
- *Receiving turn by turn directions as you walk toward your destination*
- *Reviewing messages while on the go*
- *Creating your personal big screen experience from mobile TV and video (occluded or escape mode)*
- *Seeing building schematics and locations of others (especially useful for security or firefighters)*
- *Viewing virtual recipes while cooking without losing your rhythm*



miniaturisation
& mobile
device eyewear



augmented reality 3D imaging + stereoscopic vision without glasses *now possible*



considerations



<http://cast.ap.buffalo.edu/site/?p=116>



wearable audio system (NIME2010)

<http://wearables.cs.bris.ac.uk>



CyberJacket: A heavy duty Hein Gericke jacket for use in the field. Equipped with a CardPC, dGPS and GSM 'phone. User interface is audio (speech recognition & TTS) and/or a Jornada hand held display.

<http://ambient.media.mit.edu/transitive/papers/baurley.pdf>



<http://xorsyst.com/japan/wear-the-inflatable-dress-chair/>

practicality vs.
innovation



why sonification?

- Sonification uses non-speech sound to represent data, i.e. it is auditory encoding or auditory graphing, primarily for informative purposes, such as scientific monitoring.
- Useful in low-light or limited visibility situations, e.g. something on the body/shoulder/hat which can't easily be observed by the wearer, or in dark vehicles and workspaces, emergency evacuation
- Useful alternative to visual display for multi-tasking, e.g. when already viewing something else, as alerts and alarms, in complex visual scenarios such as aircraft cockpits
- Can display independent stream of data or reinforce and cue attention to visual display

informative clothing

- what kinds of information might users and employers want to know?
 - health
 - safety
 - communication, notification
 - social
 - physical / environmental
 - locative, locational, tracking
- which qualities should smart-wear have?
 - engaging, fun, inspiring, playful, incentives, motivating
 - energy efficiency (solar, friction, motion or body-generated power)

interactive clothing

- avoid miniaturising desktop computing paradigm and wearing (same as mobile devices, unintegrated wearable computing), i.e. avoid screen and buttons
- physical interfaces (change colour, illumination, temperature, move), tactility, vibro-tactile feedback, responsive fabrics, smart textiles, bio-sensing, enviro-sensing
- use sound rather than visual display to inform user and abstract representation to protect privacy
- context-aware, relevant information, utilise network META data

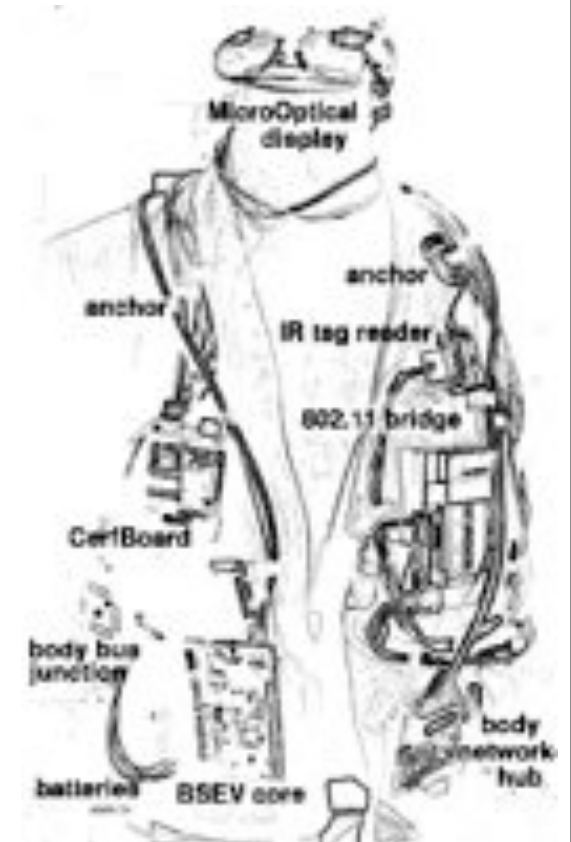


PAN* or cyborg?

*personal area network ~33ft-range,
<255 devices + mediating WPAN on std 802.15 bandwidth

<http://www.media.mit.edu/wearables/mithrill/>

- agency / control
- privacy
- inspiration vs. manipulation: wearer's experience



PAN or cyborg?

Land Warrior is a [United States Army](#) program, cancelled in 2007*, that was to use a combination of commercial, off-the-shelf technology ([COTS](#)) and current-issue military gear and equipment designed to:

- integrate [small arms](#) with high-tech equipment;
- provide [communications](#) and [command and control](#) at the [infantry](#) soldier level;
- look at the individual infantry soldier as a complete unit rather than as a segment of a larger force.

**As the *Land Warrior* program matured, it became clear that its successful deployment would hinge significantly upon the key factor of batteries.*



Personal area networks may be wired with [computer buses](#) such as [USB](#) and [FireWire](#). A wireless personal area network (WPAN) can also be made possible with [wireless network](#) technologies such as [IrDA](#), [Bluetooth](#), [Wireless USB](#), [Z-Wave](#) and [ZigBee](#).

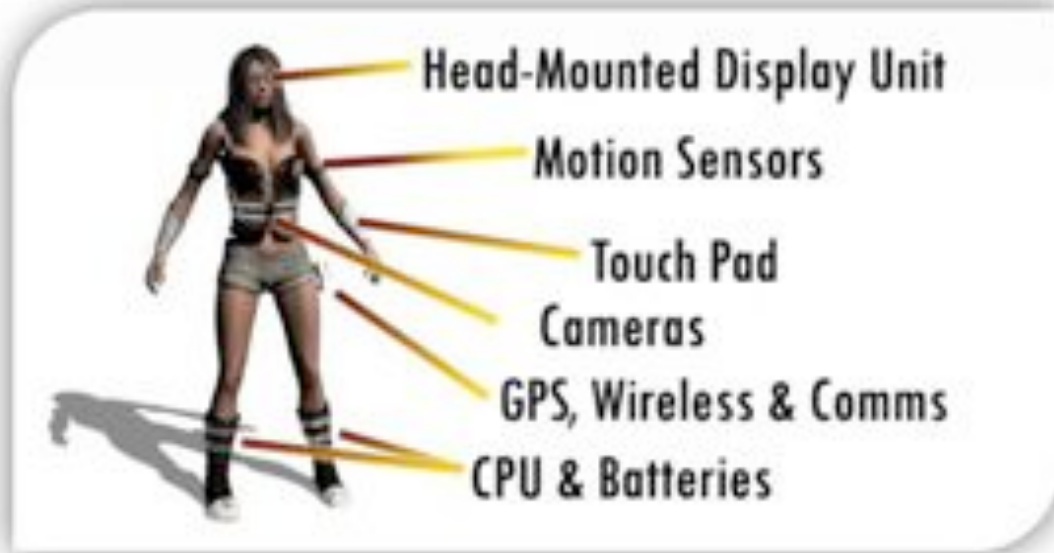
Wearable computing has transitioned from concept to reality evidenced by Eurotech Group's Zypad wearable computer. Designed from the ground up to accommodate harsh environments, Zypad is the ideal wearable computing solution for military, homeland defence, first responder, security, and emergency service field and in-vehicle applications.



The technological advancements in COTS technology and innovative engineering from Eurotech have made Zypad one of the most sought after wearable-computing devices on the market today.

In one compact device, Zypad offers a modular design to allow the user to customise the device to specific needs. Other features include enhanced power management, embedded wireless radio, biometric fingerprint reader, and multiple I/O are all aimed at providing soldiers with easy access to necessary computing power, thereby improving the success of net-centric warfare.

The advancements Eurotech has made in the field of high technology for computer miniaturisation proves that wearable computing is indeed pervasive and will continue to penetrate new and emerging markets.



http://www.ted.com/index.php/talks/pattie_maes_demos_the_sixth_sense.html
access to top-level META information

- *Minority Report* user-interface on any surface
- A few levels deeper we have wearable technology akin to Vernor Vinge's *Rainbow's End*
- After this, *Ghost in the Shell* level of human/computer integration



The office you wear

- Peter Cochrane proposes that the electronic functionality he requires for his office could be reduced in size and weight by integrating some of the components.
- *miniaturisation*: “Today [in 1999], economically priced cellular telephones employ 3 integrated circuits. However, it is feasible to reduce this to 1, requiring only 1W of power. Similarly, a laptop computer can be reduced to 2 chips consuming just 2W, with another 3W for the LCD screen (mostly for back-lighting). A further impediment to realising the office I wear is the requirement for a keyboard. But perhaps this could be overcome by voice I/O. Today, voice synthesis is [almost] adequate for text-to-speech, whilst speech-to-text still leaves a lot to be desired and will probably require a further 5 years of evolution before it can fully replace the keyboard.”
- Cochrane claims that all of the separate parts are already available and that the *wearable office could be powered by our own body*
- Sitting still, we radiate approximately 60W from our torso and head. When animated, this can exceed 100W and is a potential source of power to drive an office we can wear. Alternatively, the process of walking and moving at a casual rate can generate over 10W⁶⁸. *friction, motion, heat, electricity*

user-centred design factors for wearable technologies

- function, usability - quality of interactive user experience + interface design
- sensation
- position of interactive elements on the body (e.g. controls on left wrist for right-hander, visibility of any display, friction, damage, flexibility, motion constraint)
- size, weight, dimensions, form
- ergonomics (includes consequences of form above, but also flexibility, comfort)
- durability, resistance, washability

user-centred design factors for wearable technologies

- power source
 - battery life, recharge periodicity + duration
 - energy efficiency
 - environmental respect or green energy sources
- heat (weight, size)
- safety
- social connectivity
- communication
 - alerts alarms
 - context-awareness
 - locative data

potential use of sonification + interaction brainstorming

- when is sonification a good alternative to visualisation?
- anticipate pros/cons of sound in e-fashion (social impact, audibility, comprehensibility)
- user considerations (customisability, adjustability, privacy, ergonomics, wearability, degree of abstraction - privacy vs. publicity)
- types of info you might want to convey through wearable sonification + visualisation?

<http://www.futurephysical.org/pages/content/wearable/links.html>

http://www.wearableartblog.com/my_weblog/wearable_technology/

http://www.studysphere.com/Site/Sphere_12965.html (Articles - electro textiles)

<http://www.gtwm.gatech.edu/index/usatodaymore.html> (smart shirt alarm in emergency)