Wearable Technologies, Portable Architectures and the Vicissitudes of the Space Between

The omnipresence of the iPod and mobile phone has ensured portable and wearable technologies' highly privileged position in contemporary society. They are at the top of the pile where conspicuous consumption is concerned – you only have to visit an Apple store on a Saturday afternoon to witness the degree to which this highly sought-after gadgetry has become subject to consumer frenzy and speculation. Here, Despina Papadopoulos reviews the particular social and cultural impact of wearable devices. She also welcomes in a new generation of interactive designers who are investigating the human and emotional potential of emergent technologies.

In a world in which technological mastery has made such rapid strides, can one not understand that the desire to feel – and to feel oneself – should arise as a compensation, necessary, even in its excesses, to our psychic survival?

Jean Starobinski, 'A short history of bodily sensations', 1989[1]

With every new artefact we create a new ideology – what are, then, the ideologies that we create and embody today? As we design and appropriate wearable technologies – garments and accessories that might have embedded sensors and computational power, can be networked and incorporate electronic textiles – we also start inhabiting a new set of ideologies. These new and emerging technologies, from our mobile phones and iPods to the new breed of sensing, monitoring and reacting wearable devices, are not mere accessories in the form of opportunistic embellishments to new lifestyles, but physical, psychic and social prostheses.

We have come a long way from James Bond and Modesty Blaise, who wore their devices with style and pizzazz while promising a future where technology was sexy and at the service of transformation and freedom, to our current, seemingly limitless cyborgian visions of the self. In the process we have expanded our abilities to sense the world and each other, as well as our ability to represent our relationship to both the internal and external. In many ways we now stand at a threshold where cenesthesia, that internal perception of our

own bodies, is actualised in our transactions with ourselves and where the history of the body, its organs and substances have indeed become obtuse models of the functioning of human society. Conversely, structures and metaphors in society are becoming imprinted on the 'technological body'. Mobile phone cameras, the photo-sharing application Flickr and video blogs have become the intimate answer to surveillance cameras and radio frequency identification (RFID) tags.

Affective computing, a branch of artificial intelligence that deals with the design of devices that purport to process emotion, assumes that our galvanic skin response (GSR), our heartbeat and pulse rate are concrete and decisive, albeit algorithmically determined, signs of our emotional state. Such a reductivist reading of the self is in line with our modern fascination with reflexivity and representation. We now have garments that can monitor our function so we now can *see* what we *feel*.

What would Marcel Mauss, the French anthropologist who in 1934 talked of body techniques and habitus, make of this complex network of devices, emissions and transmissions that surround us? For Mauss, habitus involves those aspects of culture anchored in the body and its daily practices. Operating beneath the level of ideology, these patterns of motion belong to the acquired practices of the human body. What kind of body techniques are we developing today as a result of our reliance on wearable technologies? While in the past our habitus evolved over time, tradition and culture, we are now thrust into new actions and reactions engineered by labs and R&D departments. Are wearable technologies likely to become secular chasubles – portable houses that contain our relationships and fortify our neuroses?

Designers, theorists as well as market forecasters, tend to split the world of wearable technologies into military, medical, industrial, sport and fashion applications. While the first four areas have exhibited steady growth, fashion is at a loss to know how to treat technology and bring it to market. Even Hussein Chalayan, the beloved fashion designer of all wearable technologists, presented technology in his spring/summer 2007 'One Hundred and Eleven' show as a spectacle, a mythical entity that will never come to being. In the closing of the show, a series of garments were dramatically animated by a complex system of motors and wires designed by 2D:3D, the design and engineering firm that brings Harry Potter, another mythical figure, to life. While in the past Chalayan used technology to show simple interactions that accentuated the body's relationship to both social and physical space, in his latest show he presented a vision of technology that is impossible to attain and has little to do with what is possible in the seams of fabric. The complex mechanisms needed to drive the garments divorced them from anything that can actually be constructed outside a performance, thus once again presenting wearable technologies as a fantasy. But then again, fashion is about fantasy.

Going from fantasy to science fiction or to nightmare, the Future Force Warrior (FFW) initiative led by the US military at the Natick Soldier RD&E Center re-emphasises the political nature of both the body and clothes, as well as the distinct ethical and ideological dimensions of all wearable technologies. The centre's website describes the programme as follows: 'FFW notional concepts seek to create a lightweight, overwhelmingly lethal, fully integrated individual combat system, including weapon, head-to-toe individual protection, netted communications, soldier worn power sources, and enhanced human performance. The program is aimed at providing unsurpassed individual & squad lethality, survivability, communications, and responsiveness – a formidable warrior in an invincible team.'

As the remote sensing of vital organs, multi-environment dynamic camouflage, impenetrability of the body and technologically augmented senses are no longer orders of the mythical but success criteria for an ultra-human warrior, they define what our bodies could be like in the near future, and what lies between desire, fear, ability and circulation in the social.

In the world of most commercial wearable devices, the significance of sense and location is reduced to a field of RFID and GPS mechanisms – and the functional primacy of a perpetual monitoring of presence. This actualises the body as a point in a grid of 'x's and 'y's, traceable and locatable, but is devoid of meaning and the sense of serendipity that is so important to human transactions and locations. Wearable technologies, in imploding our fears of privacy and collapsing the lines between private and public and between leisure and work, are invoking a world where we are always on, always available, where everything and everyone can be accessed and traced and where the moment is perpetually postponed.

In having access to information at all times, in capturing and broadcasting the moment constantly instead of living it, we are measuring and comparing emotions instead of experiencing them. By having instant access and terminal replay loops of all of our transactions, of all our moments, we run the risk of stripping them of that which makes them: transiency. Are wearable technologies to become portable architectures of surveillance, über-functionality, commerce and invincibility?

Is this new body one we want to inhabit full time? A body without frontiers or a chimerical body that will never come to being, a tease of seduction but of no realisation? At the same time, a new direction is persistently forming, one that translocates the bounding definitions of what wearable technology is and what kind of allegiances it could make. It is in this very translocation of meaning that wearable technologies are emerging as both a practice and a metaphor, defying definition and espousing transformation, appropriation and new design interventions. Technology does not change our basic human needs, just the way they are delivered and sometimes the metaphors through which they are lived.

Francesca Rosella and Ryan Genz founded CuteCircuit, an interaction design and wearable technology company based in London, after graduating from Ivrea's Interaction Design Institute. Before meeting in Ivrea, Rosella had studied fashion while Genz had studied studio art and anthropology. Together

Mouna Andraos and Sonali Sridhar, ADDRESS, New York, 2007
Mouna Andraos wearing the GPS-enabled necklace in New York which displays the 8,686 kilometres (5,397 miles) she is away from her home in Beirut.

they create wearable technologies that are about, as Rosella says, 'good experiences, not good logos'. CuteCircuit is now in the process of bringing to the market the Hug Shirt, a shirt that allows people to send hugs over distance. Hug Shirts are fitted with sensors that feel the strength and persistence of the touch, temperature and heart rate of the sender, and actuators that re-create these sensations in the receiving shirt. They work with a Bluetooth accessory for Java-enabled mobile phones, which collects the hug data and sends them to another shirt – a kind of a wearable SMS.

The idea behind these shirts is both simple and universal: how do you send someone a hug, a powerful and direct physical constriction of the body transmitting warmth and affection? Why should some of our technologies not attempt to actuate telesensing in this way? The Hug Shirt's electronics are embedded using conductive fabrics and threads instead of wires, so the shirt is washable and form fitting. Its design and style is reminiscent of action wear, and encourages the idea of a hug on the go. While it is not yet on the market, attention from the media, and the enthusiastic response the designers get every time they show it, attests to a basic human need – that of communication. Rosella and Genz believe that the Hug Shirt also appeals to the collective imagination. The designers say that everybody sees something different in it; business people will approach it in one way while teenagers will quickly think of new uses for it. The combination of familiarity – most people know how to send SMS messages – and the sense of physical closeness turns technology to interaction design for humans craving both a hug and new platforms in which to be expressive.

While CuteCircuit uses wearable technologies to bring people together and minimise the psychological distance between them, Mouna Andraos and Sonali Sridhar, interaction designers based in New York, are creating a pendant necklace, ADDRESS, that reminds people of the distance they have travelled, and how far they are from, or close to, home. ADDRESS is a handmade, GPS-enabled pendant with an alphanumeric LED display, also fitted with a USB connection to allow its owner to connect to a computer when they first acquire it. Users must select from an onscreen interface, either by pointing to a country or providing their zip code, the location they consider their 'anchor – where they were born or where home is'.

Once the necklace is given this location, it displays how many miles away it is from home, updating this information daily. Literal and poetic at once, ADDRESS is made of wood, encasing the LED display and GPS module, and metal. Its materials and design enable the device to transcend its electronic provenance and instead underline the crossings of global dwellers and their relationship to space. As the designers note: 'It serves as a personal connector to that special place: making the world a little smaller – or bigger.'

What ADDRESS manages to do is to use a locative technology associated with navigating space, and infuse it with meaning and personal direction. Space is then expanded and associations, journeys and connections become part of the jewellery. As the GPS unit calculates its position by its relative distance from the three satellites roaming the earth, owners of ADDRESS conduct their own emotional trilateration.

Joo Youn Paek, Free the Listening, New York, 2006
A pair of headphones that enable participation.

Joo Youn Paek invites people to share their music with her tongue-in-cheek headphones.

Joo Youn Paek, Self-Sustainable Chair, New York, 2006
Joo Youn Paek walking around New York City wearing her Self-Sustainable Chair, an inflatable dress that converts into a chair. The designer takes a rest on her chair. Minutes later it will deflate and she will have to resume her walk if she wants to rest again, a conceptual design that creates a playful cycle of action and reaction.

In addressing the emotional relationship we often have with objects and by using technology to create intersections between the visible and the invisible, the tangible and the imaginary, designers can pierce the 'digital bubble' that is sometimes encasing us and re-establish notions of serendipity and social functionality.

Joo Youn Paek, a Korean performance artist and sculptor who lives and works in New York, uses technology to twist, as she says, everyday objects and experiences. In wearing her twisted objects she wants to transform the habitual and redundant and give birth to new possibilities of interaction, or simply break up the routine of her daily course. In Free the Listening, a pair of headphones is fitted with a set of additional earpieces, but these second earpieces face out, inviting passers-by to lean over and share music. This design feature obliterates the enclosed private space that headphones usually create and invites an intimate interaction as the parasitic listener needs to lean in close to his or her host.

Paek's training as both a sculptor and interaction designer is evident in the meticulous way she constructs her objects and the effortless way in which she manipulates and transforms materials. She combines performance art, architecture, sculpture, electronic design and social commentary to create living objects, design interventions that revise the customarily constructed parameters of space and the interactions made possible within it. In another of her projects, the Self-Sustainable Chair, a dress made out of polyethylene, connected to shoes that pump air into it on each step, doubles as a chair. The dress slowly transforms into a chair with each step and when the tired flâneur requires some rest all he or she has to do is sit on the inflated dress/chair. The repose is interrupted when the chair slowly deflates, giving in to the body's weight and transforming back to a dress. In order to

inflate it again, more walking is required, creating a loop of action and reaction, and using the mechanics of the body to stimulate a game of recreational urbanism.

Another designer and artist who manipulates materials is Joey Berzowska, the founder of XS Labs, a design research studio in Montreal. XS Labs focuses on the fields of electronic textiles and wearable computing as well as what Berzowska calls 'reactive materials and squishy interfaces'. Her work, while playful and experimental, is underlined by a commitment to the adaptive and transformative properties of materials. In pushing them to their limits she also creates conceptual breakthroughs that allow her to build a new vocabulary for both computation and design. Kukia is a kinetic electronic dress, decorated with silk and felt flowers that animate by slowly opening and closing. The petals of the flowers integrate Nitinol, a shape-memory alloy, which makes the fluid, organic animation possible as it contracts. As Berzowska notes, 'The dress does not respond to proximity, mood or the stock market. Rather, it is an expressive and behavioural kinetic sculpture that develops a visceral relationship with the wearer'.

Joey Berzowska (XS Labs), Kukia electronic dress, Montreal, 2006
Close-up view of the dress as its flowers slowly start closing.

Instead of creating interactive garments, the designer experiments with the interactive relationship that develops between clothing and wearer.

In the design of another interactive garment – Vilkas – Nitinol alloy is used again, this time as part of a dress with a kinetic hemline that raises over a 30-second interval to reveal the wearer's knee and upper thigh. As the movement occurs independently of the wearer's wishes, a dialogue develops between the wearer and the dress. Berzowska thus explores the ways in which we can interact with our garments and the types of relationships that emerge from such interactions.

Garments designed by XS Labs play with the boundaries of the body and space, and at other times they become surfaces on which memories are imprinted. In Intimate Memory, an earlier work, a shirt is fitted with a microphone and a series of LEDs stitched on the front. When the microphone picks up a whisper or a soft blow, the shirt lights up, recording the intimate occurrence. The lights then slowly go off, one by one, leaving a light trail of a bygone event.

One of the greatest challenges in wearable technologies, and partly responsible for the difficulty in turning wearable technologies to a manufacturable reality, is finding ways to integrate electronic components to soft materials. Researchers, designers and artists alike, have been working for the past 10 years with conductive textiles and threads, trying to find construction techniques that would allow for washability, comfort and an aesthetic integration of microprocessors and fabrics.

Leah Buechley's research focuses not only on how to make this integration possible, but also on how to make it accessible. As part of her PhD at the Department of Computer Science at the University of Colorado at Boulder, and part of the Craft Technology Group, she is working on fabric-based printed circuit boards (PCBs) and construction kits for electronic textiles. Her work on the e-textile construction kit was detailed in a paper that won her the Best Paper award at the tenth International Symposium on Wearable Computing in 2006. Her work demonstrates how to use conductive fabrics and threads to embed microprocessors and simple electronic components on fabrics using craft techniques. Buechley loves the engineering challenges the medium presents and the


Joey Berzowska (XS Labs), Vilkas dress, Montreal, 2006
Demonstration of the animative qualities of the dress. The hemline starts rising, perhaps at an importune moment. The wearer then has to negotiate with the dress and pull it back down.

Joey Berzowska (XS Labs), Intimate Memory shirt, Montreal, 2004
The designer whispers to her clothes. A microphone on the collar of the shirt picks up whispers and soft blows which are then interpreted as light. The more intense the whisper, the brighter the lights, which then, slowly, like the feeling on the skin, start fading one by one.
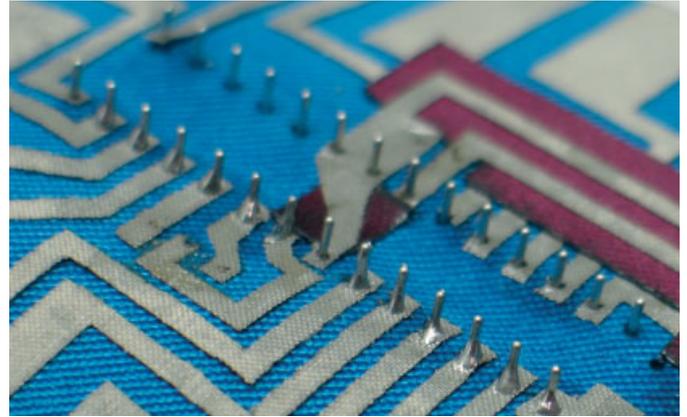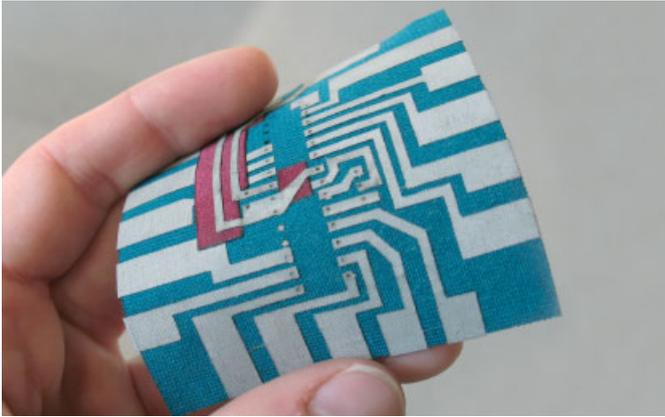
Leah Buechley, PCB fabric, Colorado, 2006
Flexible and beautiful: the PCB (printed circuit board), laser-cut conductive fabric with heat-adhesive backing is ironed on fabric.
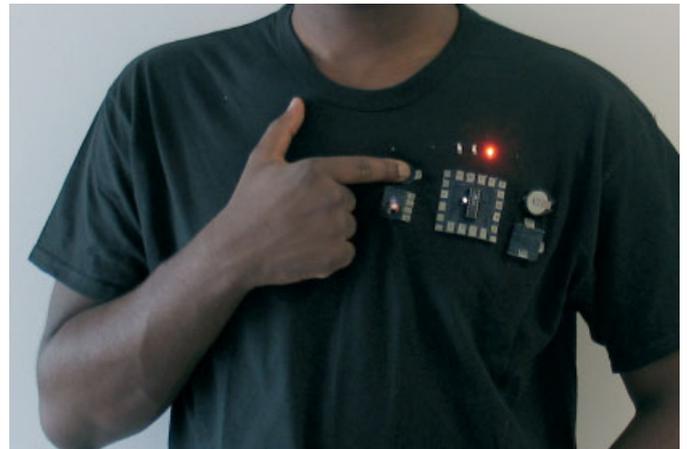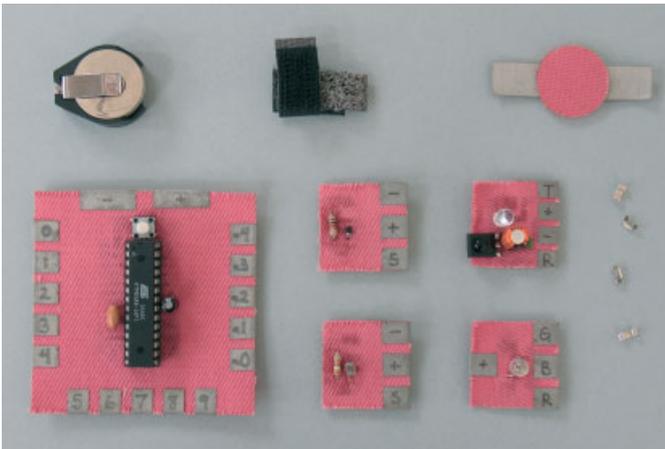
Leah Buechley, e-textiles kit, Colorado, 2006
The construction kit contains a microcontroller, an assortment of sensors and actuators, an infrared transceiver, an on/off switch and a battery pack. Each of the components is either made entirely of fabric or has been packaged so that it can be stitched directly to cloth. The e-textiles kit in action, sewn on the front of a man's shirt after assembly.

ability to combine the hardness of electronics with the softness of fabrics and in the process present the dynamic and expressive interactions that technology can make possible. Her work is both inspired and inspiring. The delight she takes in materials and her compulsion to make things, as she admits, have resulted in an uncomplicated, simple set of instructions and techniques to develop e-textiles and quickly experiment with them. Her desire to make the medium of technology more accessible, especially to women, is also driven by her desire to tackle the gender issues surrounding technology.

As Buechley notes: 'e-textiles present wonderful possibilities for changing the look, feel and culture of technology', and as the e-textile kit shows, by using craft techniques, and putting together simple electronics, designers can be empowered and actively explore the intersection of technology and its expressive potentials.

By giving access to the tools of the formative technologies that surround us to a larger group of designers and practitioners, new ways of thinking about interaction, space, social articulations and expressions can emerge. Situated outside fashion yet flirting with its possibilities and ramifications, outside architecture yet aware of its power, not quite art yet inspired by art's ability to reframe the world, we can approach wearable technologies as a series of modules that touch on all that surrounds us and inspire new possibilities for all. ⚫

Note
1. Jean Starobinski, 'A short history of bodily sensations', in Michel Feher with Ramona Naddaff and Nadia Tazi, *Fragments for a History of the Human Body*, Part Two, Zone Books (New York), 1989, p 370.