Fashion as a Communication Medium to Raise Environmental Awareness and Sustainable Practice

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Abstract

Growing concern around ecological issues is prompting ever more reflection on human attitudes and actions within our environment. Environmental data is increasingly being sought to build awareness of the impact of human behaviours, and encourage action towards the adoption of more sustainable practices. More and more, technology is being developed to monitor and publish environmental and related data. In addition, miniature and embedded technologies are now so pervasive to be integrated into clothing, enhancing the functionality, interactivity, and well-established communicative qualities of fashion. In seeking innovative ways to make environmental issues connect meaningfully to individuals, this paper proposes that by using technology to augment the responsiveness of fashion, we can have a more sensitive experience of our environment, leading to a better understanding and ultimately increased consideration for our actions in that environment.

Introduction

Growing concern around ecological issues is prompting ever more reflection on human attitudes and actions within our environment. Problems of anthropogenic climate change, waste and its management, overexertion of the planet's resources, destructive methods such as over-fertilisation in modern agriculture and material/product manufacture as well as other land care issues, to name a few, all bring our attention to the impact and sustainability of human activity on the environment. Reflection on the nature of this interaction continues to reveal long-term consequences, and an inherent lack of sustainable practices.

Technology has been useful in helping measure, monitor and publish environmental and related data. Global networks of scientific knowledge and information sharing now provide a level of transparency regarding environmental issues. Tracing a product's origins, viewing your city's pollution data, or calculating your own carbon footprint is now easier than ever before (Paulos, Honicky & Hooker, 2009; Dada, Staake & Fleisch, 2008). Other similar recent advances have recognized the potential of technology to link actions with their consequences, guiding people towards more informed decision-making.

Over the past few years, we have seen an eco-ethical consciousness emerging that now underpins developments in almost all aspects of human life – either by necessity, or by a conscious and willing re-evaluation of various motivations. There is demand for environmental information to be delivered so that more sustainable behaviours might be achieved. Technology designers and researchers in the area of human-computer interaction and information visualization, for example, have produced such eco-visualizations, with

artistic displays now challenging traditional pragmatic data displays (Pierce, Odom & Blevis, 2008, p. 2). Communication technology in this context is becoming more subtle, creative and pervasive, providing points of reflection and persuasion pertaining to one's environmental behaviour. Many eco-visualizations are fixed displays that have been designed for home or office use-contexts, with varying levels of control by dwellers or a third party (e.g., building managers or owners) (Pierce et al., 2008, p. 3). To offer more control and participation, hand-held mobile technologies have been introduced as monitoring devices (Paulos et al., 2009).

Smaller and more pervasive still, steps are being taken towards the seamless integration of technology into fashion and the clothes we wear, a testament to the increasing ease with which technology is absorbed into everyday life. This development also supports the aforementioned desire for increased information and communication, via an already established channel. As stated by Barnard (2007, p. 170), "fashion and its communicative function [is] well understood in Western cultures". The way clothing is used across different cultures, generations, social classes and any number of sub-cultural affiliations, is one way in which people decipher and assign meaning. The semiotic/structuralist approach to communication theory, as first propounded by Saussure (1959) and Peirce (1977), offers a framework within which fashion can be seen to operate. Consumers in society engage with goods as signs, actively manipulating them to communicate status and intent (Barnard 2007, p. 159). Veblen (1899) and Simmel's (1904) theories further describe the inner working of the fashion system, noting the shared perceptions that exist in society of 'how to read' different clothing items, and that allow shared meanings to be conveyed (Barnard 2007, p. 154).

The intersections between *communication technology*, *environmental sustainability* and *fashion* offer many novel opportunities for information collection, communication, and social interaction. The elements of subtle and miniature embedded technologies, interest in environmental information displays, and fashion's capacity as a base for responsive and persuasive technologies combine to form a dynamic interface between the body and its surrounding environment.

Situated within this context, this paper presents a critical review and discussion of ways that both technology-enabled clothing as well as fashion as a communication medium itself can be used to inspire action towards greater environmental sustainability. The term 'technology-enabled' is used here to denote wearable technologies and intelligent textiles. The ultimate goal of this research was to promote environmental awareness and practice in the hope that it inspires reflection on, or change to, one's own behaviour in line with environmental sustainability principles. In seeking innovative ways to make environmental issues connect

meaningfully to individuals, this paper proposes that by using technology to augment the responsiveness of fashion, we can have a more sensitive experience of our environment, leading to a better understanding and ultimately increased consideration for our actions in that environment.

Rather than trying to cover every development in each of the three areas of technology, environmental sustainability and fashion, this paper takes a more selective and conceptual approach, concerned with the crossovers of these areas, and the possibilities therein for increasing environmental awareness (Figure 1). There have been fascinating developments between any two of these elements, however much fewer that harness all three. To gain an understanding of the developments between each of the components, this paper will first explore the intersections of (i) technology and environmental sustainability, (ii) fashion and environmental sustainability, and (iii) fashion (including other textiles) and technology. The few projects that align with all three elements will then be discussed, concluding with suggestions for further contributions in the area of fashion, communication technology and environmental sustainability.
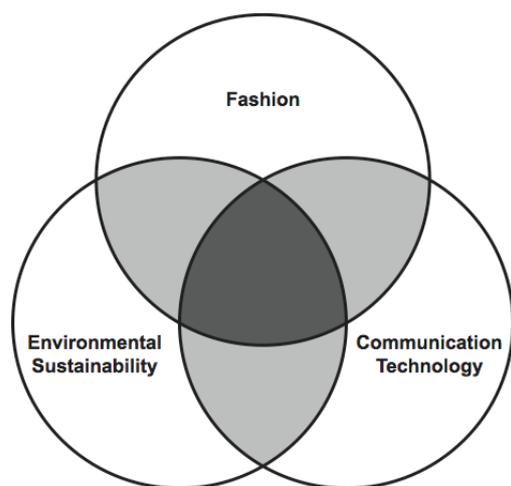
Figure 1: Areas of critical review and analysis

It is hoped that the brief survey of developments at each of the four intersections, along with the further project proposals in this context, can provide inspiration for designers and researchers in working towards more sensitive, informed and sustainable ways of being in the world.

Technology and Environmental Sustainability

Before noting examples of projects at this intersection it is useful to first explore some of the current trends within technology, revealing changing perceptions of its function in society. The major concept underpinning these developments appears to be that of a 'humanising' of technology, with much thought on, and work towards, developing more human-centric and affective designs, tools, devices and programs (Norman, 2004).

Interviewed in the MIT *Sloan Management Review* (2007, p. 51), Professor Erik Brynjolfsson describes a "thematic change in the way business is done using the Internet ... from cost-cutting and efficiency to an emphasis on supporting innovation, creativity, collaboration and information sharing." Brynjolfsson later explains the common themes between initiatives like Wikipedia and Google to be understood as "collective intelligence" (p. 52), further illustrating the transition from, as Adjei (2003, p. 74) describes, one-way electronic mass communications to interactive and networked communications.

Alongside this reorientation on a communal level, individual computer use can also be seen to have grown towards a more personal role in people's lives. Atkinson (2008) uses a social constructionism model to demonstrate the development of mobile computing as not "a linear, logical progression of miniaturization ... a technical determinism" (p. 1), but one of fashion and style. Atkinson proposes that the success or failure of mobile computing products since the 1970s has depended on their ability to provide status and enable role-setting, their semiotic associations, and the body language their use dictated.

Like almost any other consumer product, mobile computing and communication technologies have succumbed to fashion and style, with an important role in the construction of identity. Fortunati, Katz and Riccini (2003) explore the different ways technologies are assimilated into people's lives, bodies and homes, bringing implications for individuals' self-images and social relationships. In this volume, Lobet-Maris (2003) raises the interesting point of the role mobile technologies play in staying connected (or even existing) in increasingly fragmented urban contexts – "Being connected to the network is the new way of being there, the new way of being oneself" (p. 91). This shift into always-on, digitally enhanced relations has to a degree helped erode conventional understandings of home and family, socialization, time and space.

Existing in this seamlessly hybrid virtual/real world, however, is becoming ever easier, with processing, bandwidth, storage and memory continuing to get cheaper and cheaper (Sloan

Management Review, 2007, p. 51). Technology companies are scrambling to produce downloadable applications for one's every need – from books to health and fitness, medical advice, and recipes (see Figure 2). One area that has been hugely popular is that of location-aware applications. Mathew Honan's article for *Wired Magazine* (2009) tracks the elements for and against this new wave of super-consciousness, weighing up the convenience of knowing where anyone or anything is at any given time, with the concerns of privacy and security. The private becomes public.

Figure 2: Navigation and weather applications available from Apple
(http://www.apple.com/iphone/appstore/)

These trends and developments reveal technology bringing people together, helping to form identities, increasing our communicative abilities, and our awareness of other people and things around us. Whilst some aspects of location-aware applications, for example, may seem threatening, many technologies have inspired participation and helped connect people in positive ways – in the following examples, towards environmental sustainability.

Numerous researchers have championed the use of online networking and publishing technologies to mobilize action around common concern for the environment (Dourish, 2008a; Dourish, 2008b; Foth & Matthes, 2007; Mankoff et al., 2007). Suggestions abound for ambient displays in the home, workplace or community to display changing levels of energy or water consumption to provide points of reflection on our use of resources (Bray, 2007; Davis, 2008; Loke, Singh & Le, 2008; Ljungblad, 2007). Projects such as MILK (http://milkproject.net/, 2005) create stories through GPS, making visible the lines of connection in the movements of international food trade, in this case milk produced by Latvian farmers and finally consumed by Dutch citizens. A similar combination of GPS, sensing and online publishing technologies has been suggested for clothing to build meaning throughout the entire product life cycle (Aipperspack, Oehlberg & Jerrery, 2007).

Figure 3: Urban Atmospheres aim to effect positive societal change through encouraging everyday citizens to gather and publish readings such as air quality, temperature and humidity. The 'Citizen Science' research project pictured here used sensor-enabled street sweepers to collect air quality readings around San Francisco (http://www.urban-atmospheres.net/CitizenScience/).

Research groups such as Urban Atmospheres encourage a participatory urbanism, empowering citizens to collectively author, share, and remix measurements from their environment (from sensor-enabled mobile devices), in the hope of moving towards an improved understanding of the emotional experience of urban life (see Figure 3). This dynamic and democratic new form of monitoring will, as Urban Atmospheres writes, see "new metaphors for visualizing, interacting, and interpreting the real-time ebb and flow of urban places emerge". Christian Nold's Biomapping (see Figure 4) is a similar community mapping project engaging citizens (wired with a device to record galvanic skin responses) in tracing areas of high or low emotional arousal. Communal emotion maps are constructed to help visualise the social space of a community. In such examples, the mobile phone is no longer just a communication tool, but a powerful networked platform. Paulos et al. (2009, p. 416) champion this new role, encouraging a celebration of the mobile phone as a "personal measurement instrument capable of sensing our natural environment and empowering collective action through everyday grassroots citizen science across blocks, neighbourhoods, cities, and nations."
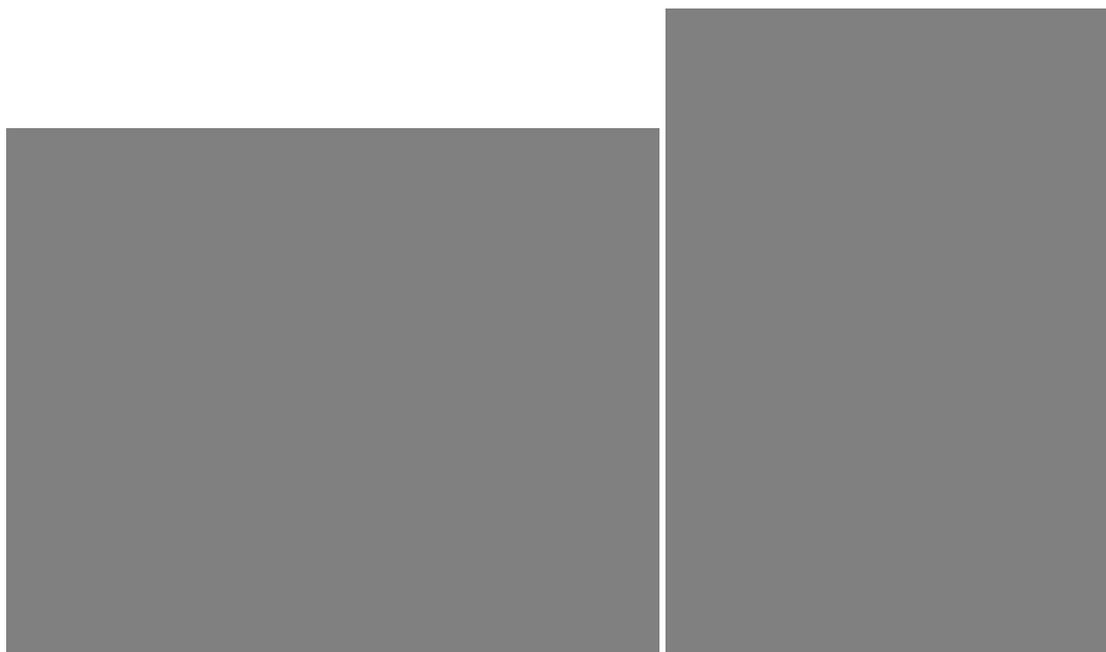
Figure 4: Emotion maps created in various cities provide unique insight, measuring levels of emotional arousal and including comments by participants on the places they encounter (http://www.biomapping.net/).

These varied projects provide much inspiration for applying technology to the issue of raising environmental awareness. Technology can be used to provide information and prompt reflection, connect like-minded people, and empower citizens to participate. Another important aspect is that of using technology to develop richer stories around products, to strengthen and make more sustainable user-object relationships.

Fashion and Environmental Sustainability

The 'green movement' in fashion is just one aspect of the fundamental shift towards a more conscious consumerism within many varied and rapidly growing product and service markets worldwide. Major environmental concerns as mentioned previously are particularly relevant to the fashion industry and its use of energy, resources, animals and the environment. In addition, increased knowledge of worker exploitation, child labour, disease and work-related deaths in the developing world has also led to the establishment of fair trade laws and practices.

A broad range of issues are involved in moving towards a more sustainable fashion industry. The eco-friendly clothing sector is slowly becoming more widely pursued, however, as awareness of these issues and increased knowledge of the importance of sustainability become imperative and more widely circulated. High-profile ethical and environmental

campaigners and their labels (U2's Bono and wife Ali Hewson's *Edun*, Stella McCartney, Katherine Hamnett, *Noir, American Apparel*, see Figure 5) have perhaps been most successful at raising public awareness, recognizably pushing the sustainable issue, and transforming the traditionally dour image of eco-fashion into a cool, educated and proactive stance.

Figure 5: Edun sends ten dollars from the sale of each 'One' t-shirt towards fighting disease, poverty and AIDS in Lesotho, Africa (http://www.edunonline.com/). Organic cotton t-shirts display slogans by Katherine Hamnett, veteran UK designer and inventor of the concept of stylish eco-fashion (http://www.katharinehamnett.com/).

On a more mainstream level, major clothing groups (*Patagonia*, *Nike*, *Nordstrom*, *Levi's*, *Timberland*, *Eddie Bauer*) have moved to improve their monitoring of ethical manufacturing processes, whilst incorporating the use of organic materials. The burgeoning global eco-consciousness has prompted many large companies such as these to review their public image, enhancing levels of corporate responsibility to attract and retain customers now more sensitive to ecological considerations. British retail giant Tesco has taken significant steps towards this goal, with several initiatives including cutting the carbon footprint of new stores built by up to 70 per cent (aiming eventually to build zero carbon stores), supporting nominated charities, a commitment to reduce-reuse-recycle at all levels of operation, starting to label products with their carbon footprint, and measuring and publishing Tesco's own carbon footprint for transparency and to set long-term goals (http://www.tescoplc.com/plc/corporate_responsibility/).

It could be seen that such retail environments now become more important as sites in which consumers have the opportunity to 'choose green.' As expounded by Dourish (2008b), being sustainable incurs a personal moral choice or reflection at the point of consumption. Dourish argues that the market thus features strongly in people's environmental behaviour. In this context, fashion as an already expressive medium has potential to bolster the environmental argument, persuading and motivating change. Australian and New Zealand fashion chain

Supré joined Greenpeace's Great Whale Trail in 2008 with t-shirts that declared "Whaling Sucks" (see Figure 6). This campaign attracted obvious criticism due to *Supré's* status as a fast-fashion chain, as well as the lack of campaign support or follow-up such as further information or ways to act on this issue for interested consumers (Valvasori, 2008). *Supré's* approach to promoting an ecological cause highlights the importance of transparency and integrity in such endeavours.

Figure 6: Supré's 'Whaling Sucks' t-shirts on sale in Melbourne, 2008 (http://farm3.static.flickr.com/2377/2256966396_7bc3d09168.jpg?v=0).

Despite critics' reservations, however, *Supré's* anti-whaling campaign did undeniably raise public awareness, and could be considered a success from this angle. This could be attributed to the product's visibility in nation-wide stores, and the rather rapid dissemination of its message to a young and receptive target market. The bold t-shirt graphics conveyed a strong moral stance that empowered consumers to act and choose. The slogan prompted reflection on an important issue and one's own attitudes and beliefs, whilst providing a means for people to connect and feel a part of something important. In such a way, fashion is able to gain attention, communicate and question accepted norms. Fashion can motivate change towards more sustainable practices by inspiring people to commit, and identify themselves with the support and collective belonging to like-minded individuals. These motivational qualities of clothes as unifying mechanisms are evident in the explicit and implicit uniforms continually manipulated for expression and social functioning. The social and cultural significance of uniforms has been discussed in detail by Craik in *Uniforms Exposed: From Conformity to Transgression* (2005).

This brief section presents a glimpse of the partly established yet deepening relationship between fashion and environmental sustainability. It is one that revolves around increasing awareness of environmental issues, and the consumer attitudes and motivations this can

influence. The rapid cycle of fashion and its commitment to novelty are obvious challenges in addressing sustainability. However opportunities exist in the expressive and identity-forming qualities of fashion to communicate environmental values. Demonstrating environmental consciousness may persuade or motivate others to follow, as seen with the examples of high profile campaigners and *Supré*. It is these expressive and motivational qualities of fashion this research aims to utilize in the promotion of environmental sustainability.

Fashion and Technology

For almost ten years, developments in technology-enabled (as understood in this paper) clothing have continued to gain research interest in many fields. The strive towards enhanced functionality of textiles has long been underway, with a major focus now on more seamless integration of electronics to form intelligent systems (Mattila, 2006). Encompassing much more than just electronics, however, Mattila (2006) provides a comprehensive account of the main areas of development in intelligent textiles, including phase change materials used for thermal regulation in sports/outdoor or protective wear; shape memory materials used for medical, clothing and composite materials; chromic (colour change) materials; and conductive materials used as sensors within clothing (e.g., bio-sensing for medical, military or sports performance, see http://www.vitaljacket.com/).

Intelligent systems such as these only hint at the array of new possibilities for sensitivity and awareness within materials. Humans interact with countless textiles in daily life; how might all this be affected with greater levels of responsiveness, comfort, hygiene, communication, information display, feedback, interaction and entertainment? (See Philips' interactive LED displays, www.lumalive.com/business/).

Philips is one company that has continued to produce work in wearable electronics and smart textiles, publishing a book of prototypes, *New Nomads*, in 2000. This book featured communications enhanced corporate suits, bio-sensing and audio enabled sports and extreme weather gear, and interactive playsuits for children, among others (see Figure 7). Whilst their incorporation of electronics into clothing now appears clunky, the conceptual basis focused on technology's "functionality and ability to empower humans ... to increase our reach and expand our senses" (Stefano Marzano in Eves et al., 2000, p. 4).

Figure 7: A selection of Philips' New Nomads prototypes including the 'microclimate jacket' providing atmospheric protection and music on the move, the 'surround sound audio jacket' enabling personal downloadable music with inbuilt earphones, the 'no kidding playsuits' enhanced with games and monitoring capabilities for parents, 'perfect performance sportswear' with audio functionality and body monitoring, and the 'nomadic working suit' designed for the corporate sector and featuring an integrated mobile phone.

Stead et al. in their project *The Emotional Wardrobe* (2004), place technology as a "poetic interface" between the individual and the outside world (http://www.emotionalwardrobe.com/). They shift the emphasis from human-computer interaction to computer-aided human-human interaction, creating a "more personal and provocative definition of self" (p. 282). In *The Emotional Wardrobe*, moods are inferred by the garment (using body language, galvanic skin response, heart rate, and temperature sensors), which are then fed to the garment server, and displayed as one of eight emotions using electroluminescent panels that illuminate in sequence and transform in light intensity and colour.

Technology's expressive capabilities in this softer, social and cultural context has inspired many explorations around the body and its environment and interactions using responsive and interactive technologies and textiles. Fashion's proximity to the body, its mobility and inherent communicative ability has here been recognized as an ideal carrier of such perceptive and personalised technologies. The conventions and cultures of fashion respond to those of mobile technologies in the sense of connecting people with the social world through communication and expression, as explained by Design Probes (http://www.designprobes.com/DesignProbes.html) – a research group working at the convergence of fashion, digital technologies and materials science. Design Probes uses a participatory design methodology to mobilize participants' tacit knowledge, and anticipate evolving user dynamics in projects such as *The Emotional Wardrobe* using ICTs to enhance the emotive qualities of fashion, and "Communication-Wear" – a clothing concept that

augments the mobile phone by enabling remote exchange of expressive messages through touch and presence.

XS Labs (http://www.xslabs.net/intro.html) takes yet a softer approach, working with electronic textiles and reactive garments that mediate the subtleties of emotional response. Director Joanna Berzowska advocates aesthetics, personal expression, and the idea of play over the prevalent utilitarian focus of wearable technology design on universal connectivity and productivity applications. Mintymonkey's *Puddlejumper* project (www.mintymonkey.com/puddlejumper_p1.html) was similarly focused on exploring a simple interaction and play, simulating external conditions (raindrops falling) with expressive qualities of electronic circuits (see Figure 8).

Figure 8: Mintymonkey's Puddlejumper is a luminescent raincoat that glows in the rain. Hand-silkscreened electroluminescent lamps on the front of the jacket are wired to interior electronics and conductive water sensors on the back and left sleeve. When water hits one of the sensors, the corresponding lamp lights up, creating a flickering pattern of illumination.

International Fashion Machine's artist and technologist Maggie Orth also crafts playful interactive experiences with her patented 'Plush Touch' lighting sensors (http://www.ifmachines.com/). This project highlights the continuing desire for tangible, tactile and sensory experiences of the things we interact with, despite the gradual push of technology into more and more aspects of human life.

The idea of sensory experience and connection introduces the emergent role of presence in remote communication technologies. Digitally enhanced apparel has been used to encourage remote empathic connection between geographically distant individuals through the real-time transference of heartbeat (Heiss, 2007). The unique ability of technology-enabled clothing to create sensory experiences felt directly on the wearer's skin is an interesting way of promoting awareness, response and interaction.

Intelligent textiles have also been developed in interior contexts to respond to environmental conditions (*Blumen Wallpaper*, http://www.loop.ph/bin/view/Loop/WebHome), and the movements of inhabitants (http://www.remotehome.org/). Such projects scope the possibilities of life within walls that literally breathe, think, and speak.

A broad range of projects falls into the crossover between fashion, other textiles, and technology, each challenging traditional perceptions and boundaries. It is reasonable to assume that for many people, textiles and clothing occupy a comfortable and rather passive role in day-to-day life. It is thus interesting to note how various human interactions are affected, and many new possibilities are created, by changes in this status.

Marzano's inspirational prelude to *New Nomads* (Eves et al., 2000, p. 4-9) suggested a human-centric and conceptual approach to the application of technology. The projects in this section are pertinent examples of such an approach, applying technology to expand our consciousness both outwardly and inwardly, using the already rich platform of fashion. We have seen in these examples with fashion, technology's capacity for responsiveness, interaction, communication, play, connection, nuance and feeling, among others. With the ability for such fine readings as bio-signals and emotions, for example, we are capturing subtle data that often exists on a subconscious level only. Becoming more in-tune to our being in an environment offers a heightened understanding of ourselves, others, and the effects we feel and produce. This appreciation of both sides – the connection between the individual and the outside world, and of actions and their consequences – is what could be fostered towards greater respect for and commitment to environmental sustainability.

Fashion, Communication Technology and Environmental Sustainability

Most of the work that has already been done at the intersection of fashion, wearable technologies and environmental sustainability is creative and aesthetically pleasing, though designed only for women. Some excellent examples are found at *Urban Chameleon* (http://www.kakirine.com/chameleon/), with skirts responsive to touch, urban noise, and air pollution; *HearWear* (http://absurdee.com/HearWear/), with garments also responsive to levels of environmental noise; and Stephanie Sandstrom's *Air Dress* (http://gizmodo.com/tag/air-dress/), programmed to appear rumpled and messy when encountering high levels of air pollution (see Figure 9).

These few projects have found innovative ways to arrange electronics and intelligent systems to work in harmony with the layered conventions of fashion operating on functional, cultural and aesthetic levels. The features of communication and interaction within fashion are explored and expanded, adding an intelligent dimension to fashion as an interface between the human body and its surrounding environment.

Figure 9: Fionnuala Conway and Katherine Moriwaki of Urban Chameleon have created the Touch skirt that changes appearance with body heat; Stephanie Sandstrom's Air Dress reacts to air quality; and Younghui Kim and Milena Iossifova Berry of HearWear create garments that react to environmental sound with moving light patterns.

Our critical review and analysis of these and other projects at the intersection of fashion, communication technology and environmental sustainability led to the development of two project ideas. In the following, we outline these proposals with a view to suggest a research trajectory that is informed by some of the communication theories and practices addressing climate change and the environment that we identified in our review.

Environmental Honours

Uniforms representative of various associations are omnipresent in society. In purer forms they exist in military, corporate or religious dress. They also exist in more dilute and mutable forms in any number of sub-cultural tribes, such as surfers, Goths, or indie music fans (Muggleton, 2000). Hierarchies can be seen to exist as forms of organization within such associations. In general, more 'committed' members are placed at the top, and the more transient or newer members at the bottom or entry level. This idea of levels of achievement (hierarchies) could be applied to fashion in a way that denotes wearers' commitment to environmental behaviours. The individual's progression towards performance, appearance and display in post-modern society is well acknowledged by theorists. A greater bodily self-consciousness has evolved, along with increased "self-scrutiny in public life" (Clarke et al.,

2003, p. 163), revealing the increasing desire to be accepted and perhaps admired by friends and strangers alike.

Environmental issues have moved more and more into the public awareness, often glamourised through the support of music, fashion, and movie stars as the faces of various campaigns. The use of such celebrities pushes these issues into the 'popular' realm, making anything to do with the environment fashionable. An outcome of this is that being informed and proactive becomes fashionable too – and something environmentally conscious citizens would be proud to display. Could there be innovative and even underground (akin to cult status) ways of displaying people's environmental commitment level? The underground approach is suggested to preserve a sense of the 'in-crowd' in fashion, or even a guerrilla movement operating beneath the surface of a (hypothetical) government's sluggish attitude to improving environmental legislation.

To borrow from the cultural code of military honours, one's garment could display a level of service to the environment. Simple monitoring devices on home energy or water consumption could be relayed to the garment, and displayed via symbolic visuals (something that holds meaning for this environmental movement, and is perhaps inspired by traditional ways of displaying honours). The problem however, is that being environmentally committed goes beyond just water and energy consumption. How can a person's daily efforts to recycle, buy local and organic, use less plastic, or plant trees be measured? One option might be to have individual online 'green accounts' where people input their own diverse actions, and accumulate points based on their performance. Such point schemes have been applied successfully in various karma systems (http://www.ebay.com.au/, http://slashdot.org/), where individuals can work on their own performance and reputation, and receive recognition from their peers.

This project idea aims to initiate a code of reference for environmentally conscious individuals using technology-enabled fashion. The display of *Environmental Honours* would both distinguish and unify wearers, making visible one's connection or commitment to common surroundings. Figure 10 shows initial sketches for garments, applying intelligent systems and working to integrate design with cultural communicative and expressive functions. An additional aspect of this project could be the use of sensor technologies within these garments to respond when in the vicinity of other such garments, aligning like-minded people and prompting social interaction over environmental issues.

Figure 10: Initial sketches for garments imbued with a codified language of environmental commitment, using LEDs and conductive threads.

Life Through Garment Eyes

Much recent research work has gone into increasing the sustainability of products (Aipperspack et al., 2007; Chapman, 2005; Huang & Truong, 2007; Pierce, 2009). The repeated suggestions of which is the need to create enriching stories around products in order to increase the longevity of user-object relations. Using GPS, galvanic skin response sensors (to record levels of arousal) and environmental sensors (noise, air pollution, UV index), a technology-enabled garment could record its relationship with its wearer. It is envisaged the enabled garment could also use embedded camera technologies, powered by the wearer's kinetic energy, to capture glimpses of their surroundings. Publishing this collected data online, the garment takes on a life of its own. Moving through online visualisations of the data, the wearer is able to look through the eyes of the garment, and experience the wearer's home, a bustling city, shady park, or a quiet café through the ultra sensitive interface of the garment.

The idea of memory within garments could also be applied here. In its different journeys, the garment encounters varying emotions compiled from the sensed data: some positive, some negative. The garment might respond cheerfully (through colour, shape change etc) upon re-entering a location in which it has previously had a positive feeling, producing increased awareness in the wearer of his/her previous good experiences. On the other hand, the garment might respond protectively, angrily, or defensively according to previous measures of response in that particular location. This project idea stimulates and enhances the relationship

between wearer and garment, creating a history and increasing the sustainability of the user-object bond. The insight the garment offers increases the wearer's awareness of their environment, and their responses within that environment. Seeing the world through different eyes offers a fresh perspective, leading to increased understanding and consideration of the places we engage with (see Figure 11).

Figure 11: Initial sketches for technology-enabled garments that record the environments and corresponding responses the wearer encounters. Sensors employed include galvanic skin response, environmental noise, air pollution, and UV sensors, GPS and camera technologies.

Conclusions

The intersection of *fashion*, *communication technology* and *environmental sustainability* is dynamic, sensitive and powerful. As reflected in the project proposals above, this interaction offers numerous opportunities for information collection, communication, and social interaction; enhancing the dialogues we already engage in through clothing. Rather than offer fully resolved and immutable projects, these ideas seek to open perspectives and discussion on the areas involved. Technology's move towards increasing miniaturisation and sensitivity, the demand for increased performance in clothing and textiles, and the growing global eco-consciousness suggest great promise in this area for further research and development. Despite the practical challenges involved in successfully integrating technology with clothing, we believe one of the most important considerations is that of subtlety and design sensitivity. The human relationship with clothing operates on numerous levels, many of which are informed by subconscious responses. The importance of affective design cannot be

underestimated in influencing emotional response. In addition, clothing has always occupied a unique position in proximity to the body. Technology embedded within garments cannot dominate the very personal, tangible and intangible functions clothing imbues. Exploring issues such as these will lead to greater design resolution, and human benefit from increased environmental sensitivity within garments.

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