

Wearable Technologies for Emotional Dialogue

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Abstract

The aim of this paper is to discuss the possibilities of exploring new ways of expressing the feelings and emotions with wearable technologies. In this paper the term “Wearable Technologies” would be used to define and cover the examples of garments and accessories that have smart technologies embedded in order to create customizable, dynamic and responsive wearable products such as the computational garments, digital accessories or the digital jewelry.

People mostly communicate their emotions by observable bodily reactions such as facial expressions, gestures, and body movements. Visual expression of emotion could be augmented by adding artificial visual responses to the physiological visual responses of the body with garments and accessories. Wearable Technologies define a new experience of clothing with the possibility to create interactively changing appearances. The dynamic visual compositions defined by the user and provided by the computational processes could enhance the abilities of the user for the expression of emotions.

Keywords: Wearable Electronics, Expression of Emotions, Self Expression, Computational Design

Introduction

Clothing is a mode of communication. Besides the other ways of expressing the identity, people express their identities, their individual standing and their desired status in the society via the clothes they wear and accessories they use that build up their appearance in the public sphere. It is widely acknowledged that the things we dress on or the accessories we use make statements and express something about ourselves. That the clothes we wear make a statement is itself a statement that in an age of heightened self consciousness has virtually become a cliché. (Davis, 1992) Garments have so far passed beyond to be only used to satisfy the basic need of covering the body and already became a medium for people to communicate the identity they have desired and constructed for themselves. Clothing is not a universal visual language that conveys the same meanings with the same codes, but is widely used to communicate meanings both for the users and the viewers in all different cultures. We choose clothes to build our outward appearance in order to convey meanings for us in the public sphere. We dress up according to our identity, status and mood and let clothes express our feelings and emotions via the visual composition we have made. We reveal our choices and emphasize our personality through our bodily appearance to give an impression about ourselves. Likewise, we interpret the visual statements constructed by the appearance of other

people to perceive the meanings. We redefine our bodily appearance with clothing; with the garments we wear and with the accessories we use. We increase the expressive abilities of our bodies with clothing.

Body is the main site for expression of our emotions. We intentionally or unintentionally reveal our emotional responses with our facial expressions, gestures, vocal tones, and bodily movements. We communicate our emotions through our bodies. (Planalp, 1999) The manifestation of our emotions with the changes in our body occurs sometimes observable but sometimes unobservable whether they are controllable or not. Through the observable cues we reveal, the others try to predict our emotions and react accordingly. By this way, appearance is used to communicate emotions nonverbally to build an emotional dialogue. Besides the hard-to-control physiological appearance, we use the benefit of controlling our appearance with garments, jewelry, and accessories to express our emotions in a more intentional way. As we could reveal our emotions through the props we use, we also try to recognize the emotions of the others by figuring out the visual cues we perceive. We use the symbolic power of appearances of things not only to highlight our social self but also to control the expression of our emotions and to communicate them properly.

Self expression in the new era of communication

In today's fast paced, networked and wireless society, the dynamics of the society and the advanced communication technology determines the ways of transmitting and receiving of messages and production of cultural meanings with increasing emphasize on customization, participation and interactivity. From this perspective, the static daily clothing could not satisfy the new social needs of its wearer shaped around the need to emphasize the changing identity and communicate the changing moods and emotions interactively. In an age where identity is increasingly fluid and multifaceted, the static clothing and unresponsive materials we wear are often insufficient means of expression. Clothing designers want to create systems of clothing that react, collect information, and enrich our interactions with spaces and people. (Galbraith, 2003) Designers serve this ideal with rising sensitivity to create interactive systems that also allow user definition of final appearance. Besides the traditional ways of creating user defined clothes and personal products, the capabilities of advanced technology like miniaturized electronic components and smart materials are used to design pervasive wearable technologies with better possibilities for self expression. Miner, Chan,

and Campbell, working on pervasive devices and digital jewelry underline the need to acknowledge and even enhance the users' abilities to address the everyday personal and social needs, in designing wearable technologies for everyday life. They believe that pervasive wearable devices will need to reflect our tastes and moods, and allow us to express our personalities, cultural beliefs, and values. (Miner, Chan, and Campbell 2001) Wearable technologies increase the expressive abilities of clothes and the accessories as they serve responsive components within the garment or the accessory for a better representation and transmission of emotions by visual means. They expand the visual space for emotional exchange with other users. Wearable technologies provide reconfigurable visualities that could be shaped by the wearer by determining the composition of expressive components. Expressive components of clothing such as rhythm, physical movement or visual texture could be created through computation and new examples of new types of clothing based on computing could provide modes of expressions unachievable with traditional garment techniques. (Co, 2000)

Emotion through wearable technologies

Affective and augmented communication of emotions could be provided by the customizable clothing as they could reflect the visual compositions of final appearance defined and decided by the user. As described above, the responsive clothing has the ability to refresh its appearance according to the input computationally programmed to be provided by the user as a representation of the physiological changes occurred during emotional experience. Computational components embedded in clothes processes any kind of input and produce and output which could be audial, visual, tactile, or the combination of them. The code for computational process and the abilities of components determine the reception of kinds of stimuli to be taken as input and how they will be processed. So the output could be determined and controlled by changing the code for the processor, or by defining the input to be computationally processed, where changing the components embedded in garments would not be practical.

Besides the definition of numerous computational processes to create an output, several types of input could be defined and used to determine and control the expression of emotion. Digital technologies worn on the body could precisely detect physiological changes in the body when a change occurs in the emotional state of the user. Planalp quotes Frijda to define

physiological changes in the body produced by emotions such as the change in heart rate, blood pressure, blood flow, respiration, sweating, secretion, pupil dilation, trembling, brain waves and muscle tensions. (Frijda, 1986 cited in Planalp, 1999) All these changes could be detected and could be used as sources of input for computational response. Besides using physiological changes as input, the change in the environmental conditions could be used as well. Being more aware and informed about what is going on helps you manage your emotional expressions. The detection of definite changes within the personal space, the detection of any other wearable technology user, whether you tend to react positively or negatively to his or her presence, or the detection of a new wearable technology user connected in the same network as you, or being notified by any change in the sphere of your personal interests, receiving a new e-mail or being notified about the fall of the stock exchange, could be evaluated as potential sources for input for the system. These various inputs could be processed and end up in an augmented expression of the aroused emotion which increases your control on emotional expression. This ability to intervene the process of constructing the visuality of the clothes makes wearable technologies the suitable medium for self and emotional expression.

The output produced in wearable technologies by the computational processes could reflect the changing emotional responses of the user as the output could be programmed to be sensitive to the changing patterns of the input instantly. The interactive responses of the garment to the instantly changing stimuli could enhance the expression of emotion by acting as a virtual second face that reveals the emotions. Unlike the hard-to-control physiological responses to environmental or personal changes, the physical responses of the wearable technologies could be controlled and directed to express the emotion in a desired manner. Besides developing systems that visualize our physiological responses through using our clothes and accessories as media, we can develop clothes that could dynamically produce emotional expressions by user command in order to enrich our emotional dialogues to manage our social relations. The emotional response of the wearer to any occasion could be amplified by presenting noticeable, exaggerated visual compositions such as changing colours or textures of garments; could be hidden by not showing any physical response although it is expected from you and your smart garments, when it is socially not appropriate; or just be speculated by expressing empowered emotional responses to a situation where you socially have to react in that way. The interactive responses of clothing and accessories could be controlled, programmed, instantly changed, or reconfigured according to intentions and

could be used to enhance the expressive abilities of the user. Even the augmented emotional responses of the user could be learned by the wearable technologies and could be used to manage social interactions. Such visualization of expressions enriches the repertoire of exchanging emotions of the users of wearable technologies to enhance the emotional relations.

Different forms of wearable technologies, computational garments, digital accessories, and digital jewelry, in this sense could be used as an interface that reflects the emotional status of the wearer by ascribing meanings to the interactively changing compositions of expressive forms. As decoding facial expressions are learned to communicate the emotions, the new interactive visual means of expressing emotions could be decoded in the culture of heightened interactive communication. As we could learn to recognize the emotions from visual cues such as the gestures and body movements, we could develop an ability to decode the emotions by evaluating the visual cues that are artificially created and represented to us with the transformation of meaning production with the evaluation of communication.

Encoding and decoding emotions through wearable technologies

Wearable technologies could serve us visual compositions different than classical clothing. The new means of visibility of clothing could be decoded in meaningful statements as they are created as the products of digital, interactive communication culture. In this culture, the visual vocabulary of communication is expanded and enhanced according to the change in the definition of communication and social intercourse by the technologies like the Internet or the wireless technologies such as Bluetooth. The new ways to encode and decode messages to be transmitted evolves with the abilities of the communication technologies. The Internet, for example, provides a new virtual public sphere for several people for social intercourse, where the public exists and share the same sphere without sharing the same physical location. In such a sphere as the interaction does not involve seeing each other, evaluating the information requires deciphering the information declared by the sender according to the conventions of new media. People interact with others; communicate all kind of information with consciously made up self identities, within the context of Internet communication. They express their identities, their presence, and their reactions by visual information as well as textual information and use visual compositions to enhance their expressive abilities. In such a medium, the expression of feelings and emotions is also be converted into graphical

information and be transmitted with the textual message to enhance its expressive abilities as we lack the presence of the visual cues of facial expression and bodily movements. People use specially invented characters, the face shaped icons, the smileys, or in other words the emoticons, (which by definition reveals the relation of emotions and graphical information) to overcome the difficulty of the absence of visual cues for interactive emotional expression. People choose some certain colours, graphics or animations to empower the narration of their feelings or emotional states, they send Emoticons to reveal their emotions. Or basically, people choose certain graphics as screensavers for their mobile devices to declare their personalities or send pictures that they shot instantly with their mobile phones to add narrative power to a dialogue. In today's new media age, people tend to encode an emotional experience into a visual composition and use it to enhance the expression of their emotional states. Within this transformation of emotional encoding in new visual forms and the increasing familiarity of decoding these new visual compositions, the enhancement of emotional expression by wearable technologies become legitimized, meaningful, and even necessary to transfer the new conventions of communication into the physical sphere. As Gaver reminds us, technology may support emotional communication more directly than traditional media. (Gaver, 1999) The evaluation of social perception through understanding the new visual forms could be used by wearable technologies and create a novel experience of communicating the self in the society. The dress forms of wearable technologies and techno-textiles presents the user extraordinary and novel experiences of interaction of the body and the emotions. With wearable technologies, technology is transformed into a complementary social paradigm of the life style and personal expression within the body. (Kipöz, 2004)

Experimental examples of wearable technologies

Although wearable technologies are defined as novel clothing experience with enhanced abilities for self expression and emotional dialogue, most of the examples are still experimental prototypes that have not released yet for daily use. The domestication of wearable technologies and make them a matter of daily clothing is very dependent to the advances in parallel technologies that allow the application of technology to the objects of daily life. Luckily, besides the advances in electronic technology and computation, the developments in the material technology also gives hope to designers to be able to apply their concepts into life in near future. The continuing researches on computation and material

technology and the technologies developed so far have already prepared a basis for the development of early models and fueled exciting minds to push it forward.

Besides the developments in processor and power technologies the developments in smart materials provide the necessary background for designers to develop concepts of expressive clothes. With the studies towards developing smart textiles, highly durable, flexible, and even washable multilayer electronic circuitry can be constructed on textile substrates, using conductive yarns and suitably packaged components. Researchers from the MIT Media Lab have developed e-broidery (electronic embroidery, i.e., the patterning of conductive textiles by numerically controlled sewing or weaving processes) as means of creating computationally active textiles. (Post, Orth, Russo & Gershenfeld, 2000) International Fashion Machines, the new company founded by the MIT alumni researchers, also presented Electric-Plaid, dynamic color-change textiles, providing programmable color and pattern change in a reflective textile display. They define Electric-Plaid as a unique textile display technology and design material combining woven electronic circuits, color-change inks and drive electronics, to add time and motion to textile patterns and design. Electric-Plaid Patterns could be programmed to change over time and can be combined with textile sensors to create fully interactive textiles (available at: www.ifmachines.com). As well as this example, other materials developed in different research centres including colour changing threads, flexible displays that feel like thin cloth, and electroluminescent fibres provide new abilities for wearable technologies. The combination of computation technology and smart materials afford new expressions and applications and invent new forms of information handling and presentation. (Hallnäs, Melin & Redström, 2002) By looking at the technologies existing and the goals that are planned to be pursued to develop more advanced ones, we could make optimistic predictions about expecting more talented wearable technologies introducing new ways of monitoring our emotions via impressive visual compositions to emotionally communicate with other people.

Exploring through some of the existing examples of wearable technologies gives an idea about how the concepts could be applied to reality and helps us to imagine, even propose how they could serve us as a medium for expressing emotions. I have chosen a few basic examples of computational garments, digital accessories and digital jewelry with introducing the personal approaches of the designers and producers to draw a general picture of the applications and to construct a basis for an imagination of possible applications for near future.

The Chimerical Garment is an early example of computational garments. The chimerical garment explores the idea of technology and computation as expressive elements relating to the human body and its movement. Through sensors embedded in an arm unit, the chimerical garment responds to body movements, breath and temperature. (Co, 2000) It displays computationally created 3D graphics on the LCD embedded in the garment. (Fig. 1) Although seems bulky, it is a mind opening example on how body information could be converted into visual messages.



Figure 1

Elise Co defines halo as a system for implicitly-controllable, reconfigurable and programmable garments. A series of interconnected halo units, each with its own microcontroller and glowing light panel, receive power and rhythm input from a “mama” unit equipped with serial (from PC) and infrared (wireless from PalmPilot, other halo) receivers. (Co, 2000) Halo is an example of a multi user garment. A halo could interact with the other halos around and use this input to create a dynamic visual pattern. Besides interaction, the user instantly could provide input for halo and could change its visual pattern. This input could easily be controlled and emotions could easily be converted into visual statements. (Fig. 2-3)



Figure 2



Figure 3

Sensatex is a New York based firm that has developed the SmartShirt. Described as "the shirt that thinks," the SmartShirt allows the comfortable measuring and/or monitoring of individual biometric data, such as heart rate, respiration rate, body temperature, caloric burn, and provides readouts via a wristwatch, PDA, or voice. Biometric information is wirelessly transmitted to a personal computer and ultimately, the Internet. The technology that has developed can detect most of the reactions of the body and converts them into the input to be processed for creating visual compositions for emotional dialogue. It gives a clear definition of how physiological changes could be measured and used for emotional awareness. (Fig. 4)

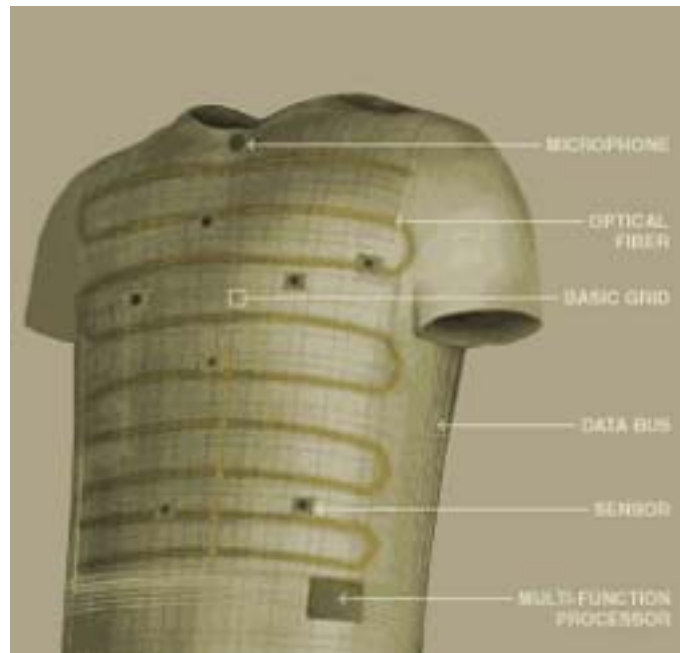


Figure 4

Besides the hard work for expressive clothes, the researches work hard also to create user defined dynamic accessories. As a frontier of a new trend, Medallion I and Medallion II are developed for allowing user defined visualities for self expression. Nokia introduces these two products by emphasizing the importance of revealing something with your appearance “Reveal your alter ego with Nokia Medallion I. Just snap a shot of your latest inspiration and upload it in an instant to this wearable display. So go ahead - reveal your hidden self. You've almost always got something to say about yourself. So say it - with the Nokia Medallion.” Medallion I&II just show JPEGs for now, but we are just one step far away having comercial accessories choosing and showing interactive videos according to our emotional needs. (Fig. 5-6)



Figure 5



Figure 6

Last but not least is the inspiring jewelry that has developed by Sompit Moi Fusakul: “Interactive Ornaments: Emotions in Motions” The name defines the concepts briefly. Fusakul has designed three pieces of jewelry that reacts and responds to the physiological changes in order to enhance the emotional dialogue between people. Jewelry systems could detect the changes and react accordingly to enrich the visual response of the wearer. The project Interactive Ornaments may be useful for partners who have difficulty in expressing their feelings. Imagine a wedding ring that tells you when your partner is jealous, or earrings

that shift colour when you are attracted to someone.(Review available http://www.e-culturefair.nl/site/index_en.html) Deirdre Crowley explains the interactive relation of the jewelry with its user, different properties and working principles of pieces as follows:

Vein 2 (Fig. 7) is a fibre optic necklace which changes colour as the wearer's heartbeat increases to reflect their mood – blue indicates calm and red excitement. In order for it to work, the wearer has a jogger's heart-rate monitor strapped to the chest. This sends a radio signal to a receiver and circuit board in the jewellery. A custom-made microchip counts the heartbeats and has been pre-programmed to command certain LEDs to light up in sequence. Anemone (Fig. 8) is a shoulder piece, which wraps around the body. Light pulsates from flowers plated in Thai rose gold in rhythm with the beating heart. The third design, Aliform (Fig. 9-10), meaning 'a structure with wings', consists of nine elliptical shapes cut from iridescent film. In response to five heartbeats, the elliptical shapes swell in sequence as instructed by the microchip embedded in the piece. (Crowley, 2002)



Figure 7



Figure 8

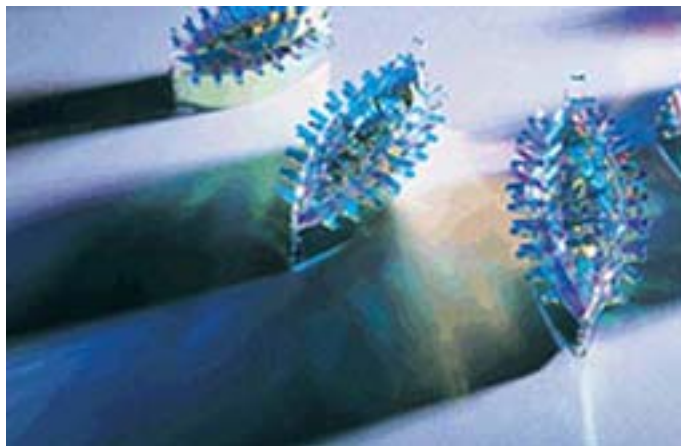


Figure 9



Figure 10

Conclusion

As we could analyze from the examples, Emotions could be expressed by new visual forms by using technology as a design material. Technology serves us new possibilities to create reactive and dynamic modes of self expression. The expressive ability and charming beauty of interactive visuality could augment the communication of emotions with tangible applications defined within clothing. Nonverbal communication is the primary medium for emotional dialogue. We communicate our emotions mostly through the changes that reflect to our appearance. We reveal our emotions with visual cues such as facial expressions and body movements, and decipher the emotions of others by evaluating these observable cues.

Clothing is used to construct the body image and used as a medium of self expression but the static clothing used to construct the appearance of its wearer could be insufficient to participate in emotional communication especially in an age of interactive visual communication.

Wearable technologies allow refreshing the outward appearance according to the changes in the emotional state. Computationally controlled garments and accessories could detect the need for expression and transmit visual messages appropriate for the context. Wearable technologies help to express the emotions by coding the emotional responses in visual compositions. Computationally defined visual expressions of emotions through the reconfigurable and interactive compositions enrich the repertoire of emotional communication. The coded visual compositions facilitate the expression of emotion for the

user and cognition of emotion by the viewer. By this way the clothing become the complementary medium of communicating emotions and naturally enhances the expressive abilities of the self by broadening the channels of communication. The new channels of communication could be used to amplify, to hide or to fake emotions and provide a degree of control over the expression of emotions desired for management of social intercourses.

Wearable technologies provide a new medium for representation of emotions different than the physiological visual changes or the vocal and the verbal expression of them. The new medium provides novel experiences to the user in self expression and helps us to explore the visual representation of emotions with computationally controlled user defined compositions. Understanding new ways of symbolic exchange of emotions through wearable technologies help us to explore the newly emerging language of emotional exchange by responsive smart technologies. Studying conventions of emotional dialogue via wearable technologies also contributes to new areas of research for studying design and emotion for computationally controlled objects and environments.

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Gökhan Mura has recently obtained his MA degree in Visual Communication Design from Istanbul Bilgi University, where he was awarded with full scholarship. He has a background in Industrial Design. In his dissertation, he has questioned the transformation of the representation of fashion information with the emergence of wearable technologies, within the historical context of visual representation of dress from early modernism till today. Besides his interest in culture of visual communication, he is also interested in the advance of technologies enhancing the expressive abilities of objects that constitute a better communication between the self and the environment via physical interaction design.