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Unfolding and Refolding Embodiment into the Landscape of Ubiquitous Computing

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ABSTRACT

This paper advocates the future of the body as a distributed and shared embodiment; an unfolded body that doesn't end at one's skin, but emerges as intercorporeality between bodies and the technological environment. Looking at new tendencies within interaction design and ubiquitous computing to see how these are to an increasing extent focusing on sociality, context-awareness, relations, affects, connectedness, and collectivity we will examine how these new technological movements can change our perception of embodiment towards a distributed and shared one. By examining interactive textiles as part of a future rising landscape of multi-sensory networks we will exemplify how the new technologies can shutter dichotomies and challenge traditional notions of embodiment and the subject. Finally, we show how this 'new embodiment' manifests Deleuze's philosophy of the body as something unstable and changing, and how his refolding of the body can be useful for future interaction designers to understand the context they work in and the challenges they will meet.

Keywords

Embodiment, subject, interaction design, ubiquitous computing, sensor-network systems, interactive textiles, context-awareness, affective computing, interactive textiles, collectivity, body.

1. INTRODUCTION

Pervasive computing and sensor-network technologies are challenging the notion of embodiment: where does the body end and the technological environment begin? Here we offer a look at the vibrant, living textures of everyday life in multi-sensory networks in order to investigate the future experience of embodiment when the body unfolds into a pervasive and ubiquitous techno-sphere. An embodiment that does not end at one's skin, but instead will be inseparable from the technologies we live through.

We will in this paper look at how new trends within interaction design and ubiquitous technologies opens up a possible change in our experience of embodiment and how new technologies such as interactive textiles and sensor-network systems can extend the skin and unfold the body into the environment and thereby dissolve the border between inside and outside, between you and me, between human and technology, and between subject and object. The body and embodiment are not stable matters, and we will have a look at how these new technologies actualize

Deleuze's philosophy of the body, which suggests that we should always challenge it as a fixed concept so as to see what it can become, and how his thoughts can be helpful to understand the notion of shared embodiment and the challenges it contains.

2. NEW IDEALS OF DESIGNING INTERACTION

The history of computation has long been dominated by centralization and an exclusion of the body. Paul Dourish describes how this tendency is changing [6]. Computation is being decentralized, merges into the physical surroundings, and becomes pervasive. Mark Weiser's vision of ubiquitous computing formulated in 1995, describes how computation could be seamlessly integrated into the objects and activities of our everyday life. "*[the technologies] weave themselves into the fabric of everyday life until they are indistinguishable from it*" [23:933]. Here we will look at how new ideals and tendencies within computing are changing the way we interact with technology, and how this includes the body in new ways.

2.1 Technology is social relations and context-awareness

Paul Dourish has given the field of interaction design its own philosophy of science by drawing on phenomenological philosophers when introducing and analyzing tangible and social approaches to computing. He argues that tangible and social computing are aspects of the same research program [6]. Dourish mentions three ways in which embodiment is relevant for understanding interactions with digital technology. First, interaction designers have realized that interaction is closely connected to the context in which it occurs. Embodiment determines how computation and the setting will fit together. Second, the focus on context reflects a more general orientation to consider activities and artifacts in concrete rather than abstract terms. Tangible computing illustrates this concern by exploring the possibilities for us to manifest computation and interaction in completely new forms, while social computing seeks ways for interaction to manifest more than just a formal model of the task, but also details about how the activity is being performed. Tangible and social computing brings together artifacts and interaction, which were separated in other approaches to system design. Third, it is realized that artifacts, through their direct embodiment in the world we inhabit, can have many different roles [6]. Through Dourish it is becoming clear that interaction is

about relations, the social situation, and context rather than single entities and their individual interaction with technology.

We are witnessing a paradigm shift from one autonomous entity operating in a close relation with, knowing and understanding the user, to a paradigm where multiplicities, relations and connections are more significant, in the desire to make the technologies an integrated, fluid part of our lives. The technology not only has to understand the user, but also the whole context in which it functions. The idea of embodiment and contextualization implies the use of our full sensory apparatus, and acknowledges that our being and acting in the world is inherently synkinesthetic. This is also true when it comes to technology [14]. When we focus here on the skin and the sense of tactility, this should be seen as part of a larger system. To create an understanding and awareness of the context, the system has to detect, collect, and analyze many different factors, including not only all users and the surrounding technologies, but especially the relations between these many human and non-human actors, and the system must understand how the actors act and react toward one another. By monitoring and measuring the user through various sensory indices such as speech processing, facial expression, body gesture and movement, and last but not least bio-monitoring, these ubiquitous systems of sensory technology can achieve an understanding of both the user and the user's context that becomes a basis for the system's autonomous reaction within a set of parameters predetermined by the user's needs and desires. The technologies are to function around us and only appear when we need them. This has been described as ambient computing -- or even ambient intelligence [6:47,150], [15:2]. Such a technological environment consists of distributed sensors and technologies that are 'unintelligent' when taken individually, but which create a surrounding 'intelligence' when networked into a unified system, an ambient space of interactions resulting from the individual human and non-human components of a collective body.

2.2 The present and submerged body

In the era of new technologies, the subject has feared the loss of the body. This paper suggests that we should refold this prophecy. In the rising landscape of tangible, social and ubiquitous computing, the body is being taken into account again, but maybe not in an evident and perceivable way.

The most profound technologies are those that disappear, because when they disappear we are freed to use them without thinking. As Weiser described the future landscape of ubiquitous computing, it will be a network of technology embedded in our surroundings, which automatically senses and reacts to users and to other technological actors. The interface will have become invisible and the point of interaction, now an array of sensors, will automatically react to our bodies, but on a level where it is no longer possible to immediately perceive when and how the interaction is taking place. The meeting point between bodies and technologies will have been indefinitely spread out, and because the system is simultaneously reacting to all bodies and technologies that are present, it will not be evident who is interacting when and who is causing what. We will more or less consciously interact with the environment at all time. Instead of interfacing with the technologies, we will 'interlace' with them, as Koefoed and Wamberg express it: "*User and system are weaved together, thereby turning the digital interface into an interlace.*" [10:120 The traditional interface is connected to the interaction

between one user and one device through a clear interface that works as a representation. The interface we have to deal with in ubiquitous computing and sensor-network systems, however, is neither a surface nor a representation, but the interaction is multiple and merges with the technological effects. All are part of the social situation. They create an interplay between technological interfaces and physical bodies, an interplay that unfolds and expands through the very same interface.

The body will in this way be submerged in pervasive computing. But rather than disappearing the body becomes the center of the technologies. The body is in no danger of disappearing; rather it will unfold into the world. The body and the skin will be the true protagonists in the emerging multi-sensory and reactive network of ubiquitous computing. But the notion of the body, embodiment and the subject is likely to change in these new surroundings.

2.3 Designing towards Collectivity

"We want, instead, to be able to talk about collective experience; intersubjectively negotiated, individually incorporated, only more or less shared, and yet a common lens through which everyday experience can be made sense of." [7:9]

If we imagine a multi-sensory system as we have here described it, we see how its users become intertwined in the technology, and through the sensors the body extends out into the environment. Technology and humans create a collaborative activity. When the surroundings are reacting to all users inhabiting it, it doesn't make sense to design for single-human-interaction as HCI traditionally has. Rather the designer has to design for the collectivity, acknowledging that all people and technologies are part of creating the context and that they all interfere with each other. In the article Cultural Mobilities: Diversity and Agency in Urban Computing, Dourish develops his study of interaction design, arguing that we should design towards diversity and collective agency. When he applies this to a design for the collaborative, he emphasizes that it is not the same as designing for a multiplicity of individuals as in CSCW (Computer supported cooperative work), but rather for a collective experience, where a shared understanding and action becomes foundational to meaning and interaction. "*Thinking of collective experience in terms of a multiplicity of individuals fails to see the forest for the trees.*" [7:9].

We suggest a phenomenology of relations, collectivity and context-awareness, which implies a synkinesthetic [14] being-in-the-world, that not only focuses on the autonomous individual's being-in-the-world but instead acknowledges that being-in-the-world is a result of relations, collectivity and context-awareness emerging between a collective of users and technologies. We see a shift from entities to relations, from steadiness to process, from corporeality to intercorporeality. This results in not only changing the formal state of a well-described artifact, but also changing less formalizable states of affective and emotional qualities of our lives. When we design sensor-network systems, we have to keep this in mind.

Before we return to how these collectively based sensor-network systems will result in a shared embodiment, we will briefly reflect on how the technology gets its 'knowledge' about the users and in what ways it reacts to that knowledge.

2.4 Affective computing

“Affective computing is trying to assign computers the human-like capabilities of observation, interpretation and generation of affect features. It is an important topic for harmonious human-computer interaction, by increasing the quality of human-computer communication and improving the intelligence of the computer.” [21:1]

As already mentioned, an important part of becoming context-aware is for the technological system to understand the users. As early as 1997, the founder of the research field of emotional and affective computing, Rosalind Picard, expressed how the technology of the future must become emotionally aware of its users to meet their needs in a more effective manner. Since then, research into how computers can understand and express emotions has expanded widely. This is a very complex and controversial area of computing, and the questions of whether or not this is possible and how it can be realized are not within the aim of this paper. Rather, we wish to question how such a system would affect our feeling of embodiment. Understanding the user is of course a synkinaesthetic matter, but as this paper will soon illustrate, one of the most promising ways to achieve knowledge about the user and the context is through the skin [17]. In Picard’s work, the notion of affect is mostly as a perceptible and measurable feeling or emotion, which the technology can use to produce a corresponding response to the user’s state of mind. There is a direct cause and effect between the user’s emotions and the technologies’ reactions. Thus the measure of an emotion can be understood, represented and effectively used.

We would like to diversify the term with Gilles Deleuze’s definition of affect, which can be described as oppositional to effect. Effect and affect are related, but the difference lies in the affect not being something easily definable, *“because we call affect any mode of thought which doesn’t represent anything.”* [5:1]. The affect is a mode of thought which is produced by a variety of both internal as well as external factors such as space, time, context, ecology, culture, and personal experiences. But it is not possible to say exactly what the cause of the affect will be, what it means, or what it will bring. There is no direct cause and effect, but the affects produce a sensory or an abstract result. Affect occurs when bodies (human as well as technological bodies) come into contact. It is an indefinite and indeterminable lived dimension, which can be described as a process of change, rather than fixed to a specific meaning. Affects are happenings in which things and bodies are altered and come into being – affects are ‘becomings’, a concept that we will return to.

An important reason to use affective instead of just effective technology, is the danger of designing whole bodies of organized, responsive technologies that will always react the same way to our behavior. If we imagine sensor-network systems where the technology always reacts in the same way to certain sensor-stimuli, there is a danger of making organ-ized systems, which could create a simple repetition of our behavior and homogenize our lives; a ‘body with organs’ as Deleuze and Guattari express it. They suggest creating a Body Without Organs [4:149-167], to fight the organ-ization. Rather than being effective, the new technologies should work in a sensitive, affective, and unorganized way. The same message is being put forward by Dourish [7], who addresses the danger of designing technological systems that produce control and structure. Instead he uses

Deleuze’s idea of the rhizomatic order as opposition to a hierarchical top-down governmentality. These systems open up for *“new opportunities and new models for organizational decision-making and alignment”* [7:6].

Furthermore, bringing Deleuze’s idea of affectiveness into the design of technological systems and into interaction design creates a foundation for designing technology that is not only intended to solve problems and produce a functionalistic everyday life for us. To understand the future landscape of sensory and reactive networks, we have to acknowledge that they are not only efficient and effective systems, but they should also take part in our social lives and produce new opportunities for affective experiences [7]. As Kozel and Koefoed also express it: *“Acknowledging the sensory, affective, poetic and corporeal qualities of the moment of lived experience is key to designing and understanding the next generation of technologies”* [11:206].

2.5 The skin as interface

“Ultimately, truly wearable body-sensing can facilitate the kind of context-awareness crucial to ubiquitous computing and personalized information delivery.” [8:276]

When the technology is to perceive and understand its users reactively to meet their needs, it is a natural step to move closer to the skin in order to engage in an intimate relationship with the body. During the last five to ten years, we have witnessed an expansive use of biometric sensor technologies, not only in professional contexts such as medical equipment, sport applications and security clothes, but recently also in mundane aspects of our lives as well as artistic projects questioning the human being-in-the-world in a borderland created by body-technology relations.

Because our clothes are worn so close to the skin, and because they are already an embodied part of our lives, they are a natural place to embed calm technologies with the aim of making interaction more context-aware and affective. We see a tendency within these interactive textiles to try to imitate the sensitive qualities and communicational functions of the human skin. Small biometric sensors such as pulse-sensors, radio-frequency-sensors, galvanic skin response-sensors, thermo-measuring-sensors, tilt-sensors, electromyograms, skin conductance-sensors, respiration sensors etc. are being integrated into textiles and can sense the stimuli of the skin and the body. The sensors measure the changing physiological parameters related to the autonomic nervous system. As Picard expresses it, the idea is that the technology without the interference of the user, provides skin-surface sensing and long-term monitoring [16]. Small tactile and haptic actuators integrated in the textiles can produce feedback, or the reaction can take place as signals that make other networked objects or subjects respond to the stimuli. The textiles function as an extended, second skin, which mediates between the human body and the adaptive and responsive environment. The skin becomes a ‘Sk-Interface’ [12] through which we can interlace with our omnipresent technological environment.

3. SHARED EMBODIMENT

In *Getting Under the Skin* [22], Wegenstein uncovers how the understanding of the skin as an envelope for the body and a boundary to the world falls apart. Rather, through the sensors and actuators the body expands and unfolds into the world, and the

whole world becomes a part of the body. If we imagine ourselves in a landscape of ubiquitously sensing and responsive technology, which automatically reacts to our more or less unintended interaction, we see how it becomes difficult to separate our actions and our feeling of embodiment from our technological environment, and from other people. What I do and feel affects the surroundings, which again impacts other bodies. The feedback-loop is endless and non-linear. In the environment of ubiquitous computing and sensor-network systems embodiment is always to be understood as a relational and rhizomatic feedback-loop between a variety of actors including both humans and the richly designed and interconnected technological environment. Where the body and embodiment traditionally has been perceived as a centralized entity, our actions and body now become distributed throughout the environment and other bodies. Embodiment transforms and evolves as we move around. We are not isolated bodies or subjects, but become interwoven in each other and in the interactive landscape of technologies. This is an embodiment of relations, a dynamic process actualized through interactions with the environment. This is the concept of distributed and shared embodiment, as we have proposed.

4. WHISPER[S] – A SK-INTERFACE FOR SHARED EMBODIMENT

“Ubiquity and wearability bring our technology closer to the surface of our body [...] how does this invisibility shift our perception of ourselves. Whisper[s] explores this through physiological data – the data of our body.” [20]

The installation, Whisper[s] (developed at Simon Fraser University by a team led by Thecla Schiphorst and Susan Kozel) illustrates perfectly interactive textiles, networked technologies and the idea of shared embodiment. Whisper[s] is an art installation that acts as a laboratory to examine the feeling of distributed and shared embodiment.



Whisper[s] – with the subtitle Breathing Between Bodies - is a room of collaborative activity and interactions. It is not a room with walls that you can step into, but rather a space that you can dress in and wear; a space consisting of the relations between

bodies and between bodies and technology. In each of the eight dresses sensors and actuators are incorporated. The actuators produce vibrations and small breaths of air as reactions to the skin stimuli of the wearer, or to the wearers of other dresses. Through the technology in the dresses one person's skin/body-activity can be broadcasted to one or all other bodies. The dresses, however, don't try to imitate the emitting bodies, but instead one kind of stimuli is being converted into different outputs. Also, the place of action is not mirrored. There is no intention of direct translation of emotions or feelings. Instead of transmitting emotions and meanings by cause and effect, affects are being produced between the users and the technology. The technology is not there to communicate or solve certain messages or problems, but is instead there to take part in the social situation and provide a frame in which bodies can meet themselves, other bodies and the technology in new affective ways and thereby change the perception of what embodiment can be.

All bodies act and react to each other without knowing precisely from where and how they are being affected, and whom they affect themselves. The acting skin is being extended into the sensing textile and distributed to other bodies. With Whisper[s] it is no longer possible to think about your body as an autonomous body, but it becomes clear how the relations between humans and technology is creating a shared embodiment; *“there is a potential blurring of the boundaries between the participants as well as between what is inside and what is outside.” [18:6].* The interactions are being accomplished by a cacophonous soundscape created from all users' heartbeats. This is being played by a textile speaker wall and creates a unified body of sound. The 'textile' nerve system [1] emerges through the users' bodies and their environment, and bodies and technology are being intertwined in an affective network of interactions. The visitor in Whisper[s] experiences him or herself as emerging from the relations and the dynamics existing between the human and nonhuman entities such as the dresses and the speaker wall. *“Any one of our bodies is a 'we'. When our bodies are together they can operate as an 'I'. So can the devices in Whisper.” [19:7].*

5. REFOLDING EMBODIMENT AND THE SUBJECT

“A body can be anything; it can be an animal, a body of sounds, a mind or an idea; it can be a linguistic corpus, a social body, a collectivity.” [2:127].

We have described how new trends within interaction design and ubiquitous technologies opens up a possible change in our experience of embodiment and how new technologies as interactive textiles and sensor-network systems can extend the skin and unfold the body into the environment and thereby dissolve the border between inside and outside, between you and me, between human and technology. We will now have a closer look at how Deleuze's philosophy welcomes the same change for the body and embodiment, as we have described. Deleuze's philosophy of embodiment also changes the understanding of what a subject is, and calls for an immediate realization of such technological systems.

5.1 The becoming of embodiment

According to Deleuze the body, and embodiment, is a multiplicity and a potentiality. Deleuze's notion of the body is heavily inspired

by Spinoza, who describes the body as something dynamic whose limits and capacities we cannot know beforehand, but which can only be revealed through our ongoing interactions with the environment. When we here propose a shared embodiment, according to Deleuze and Spinoza this is a natural development of the body. The shared embodiment is not something that threatens our notion of the body, but it is rather another state of the same body. When the environment we live in and interact with changes, our body and embodiment will necessarily also change. In his book about Spinoza, Deleuze writes: *“a body affects other bodies, or is affected by other bodies; it is this capacity for affecting and being affected that also defines a body in its individuality.”* [2:123]. The body, the subject or an object is never separable from its relations with the world – bodies are modes of complex relations between human and non-human entities. We cannot know what the body and thereby embodiment is, because it is not identical with itself over time [2]. Deleuze’s philosophy is a philosophy of difference and of becoming. Deleuze doesn’t perceive our being-in-the-world as something we are, but rather something we become. Instead of asking what our subject and our embodiment are, we should ask what they could possibly ‘become’. We should ask what our technological being-in-the-world could look like – what embodiment could become in our meeting with new technological environments. Here we can return to Deleuze’s definition of affects as ‘becomings’. The body and embodiment emerge only through our interaction with the environment – in processes of relations and affects. When we interlace with new textiles and sensor-network systems, our bodies are altered in new ways through the affects these meetings produce. The picture Deleuze makes of the body and embodiment is an embodiment of relations, intersubjectivity and contexts. When the wearers in Whisper[s] meet the technological system, they meet their own bodies anew. While Deleuze’s theory pre-dates the invention of sensor-networks, we can see nonetheless how these new technologies actualize or even materialize this perception of the body.

5.2 Refolding

Overcoming the dichotomy between inside versus outside can be explained with Deleuze’s concept of The Fold: *“a fold is always folded within a fold, like a cavern in a cavern.”* [3:6]. When we use the philosophy of the fold on the sensor-network systems, the body, the skin, or the subject is no longer subordinate to or separated from the technological environment, but expands into it, merges together with it, or even better, becomes the environment. The fold is an operative function, which dissolves the Cartesian dichotomy, because it passes between the objective and the subjective. The technology is folding around the body, and the body unfolds out into the world. The skin as border loses its significance and becomes an unfolded interface to the surroundings. The body is folding into the ubiquitous technosphere, and new technologies are refolding embodiment.

We have described how this shared embodiment is attained in a system such as Whisper[s], but Whisper[s] is an art installation and an experimental laboratory and not a system implemented into our everyday lives. Besides applications such as sliding doors, automatic light and a variety of sensing applications in our mobile phones, we have yet to see these systems applied in everyday life.

5.3 The problematic subject

In rapidly changing technologies, we often experience gaps between the conception of new technologies and societal acceptance of those technologies, which evolves gradually through our interaction with our surroundings and which in fact changes the perception of even such basic aspects as the concept of embodiment and the subject.

The interwoven technologies and the coexistence of nested multiplicities in Whisper[s] blur the borders between technology and humans, between subject and object. In shared embodiment we have to give up the Cartesian subject, which has functioned as the fundament for Western liberal humanism, where the subject cuts himself off from the environment as an autonomous, pre-given and self-constituting agent. The dichotomy between the passive object versus the acting and sovereign subject - between the inside versus the outside - dissolves. The human who inhabits contemporary technological societies of reactive, multi-sensory networks has to realize the dynamic and fluctuating boundaries of his body and embodiment [13]. *“Agency still exists, but for the posthuman it becomes a distributed function.”* [13:319]. Similarly do embodiment and the subject still exist, but for the inhabitants of environments of ubiquitous technology, it is becoming a shared and distributed process.

Thinking about embodiment and the subject as rhizomatic relations and dynamic processes rather than stable entities changes everything. But there is one problem with this concept of embodiment. Throughout the last 250 years the world and order of things has been built upon the understanding of the subject as the center of the world [9], and the body and embodiment as something autonomous. Eliminating this conception produces chaos and fear. To design systems of this order, the user’s perceptions of the subject and embodiment must be changed. But this is more easily said than done.

5.4 Slowly moving toward a new concept of shared embodiment

It is not easy to move users to a new concept of embodiment. We have to keep in mind *“how necessary caution is, the art of dosages, since overdose is a danger. You don’t do it with a sledgehammer, you use a very fine file.”* [4:160]. To design towards collectivity and shared embodiment, we have to take into account the existing paradigm, so as not to trip over our own feet and frighten users.

Designers have a philosophical responsibility, because they don’t just design physical devices but also shape overall concepts, such as those of the body and of social relations [6]. Additionally, we want to instill in them the responsibility of attempting to design in a way that both encounters the users and their perceptions, and at the same time challenges them and the existing paradigm. To change something, one must alter it slightly over time and make sure that it is never unrecognizable, but always slightly different version of itself. One must be sure to design the change with the right dose and timing, as Deleuze points out [4], and not only ask when the technology is ready for the market, but also ask when the users are ready for the technology, and help them to get ready. We believe that the philosophy of thinkers such as Deleuze can help designers in this context.

6. CONCLUDING REMARKS

In this paper we have investigated the future of interaction in a rising landscape of pervasive and ubiquitous technology. We have suggested how this interaction might change the experience of embodiment, when the body unfolds into a sensor-network system and there meets both other bodies and a vast variety of technologies. We propose that instead of diminishing, the body will unfold into the world. We suggest a phenomenology of connections and of context-awareness, which implies a new space for the body and for embodiment to develop in and take new shapes, and to become a distributed and shared embodiment. We have shown how the thoughts of Deleuze are being actualized, and can in fact not only help us to understand and embrace this new notion of embodiment, but also assist us in understanding how we as designers must approach the realization of this new concept of embodiment carefully and with a gradual pace of change so as to permit its societal acceptance.

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