Interfaces beyond the Surface:
A Structural Approach to Embodiment

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Abstract

This work aims to contribute to the theory and practice of embodied interaction. It criticizes that its underlying term of *Embodiment* has not been defined sufficiently, and is, consequently, used inconsistently. It also argues that this circumstance is a problematic one. It presents an attempt to provide more clarity to the theory of embodiment, as a basis for the practice of designing embodied interaction in *Tangible User Interfaces* (TUIs). It proposes a purely structural approach, derived from Heidegger's works around 'Being and Time' [3]. Aspects and criteria of Embodiment (as which Heideggerian *Dinglichkeit* is interpreted) in the literature are reviewed in this work, and applied to the design practice of Embodied Interaction.

Keywords

Embodied Interaction, Theory, Tangible User Interfaces

ACM Classification Keywords

H5.2 [Information interfaces and presentation]: User Interfaces. – Haptic I/O.
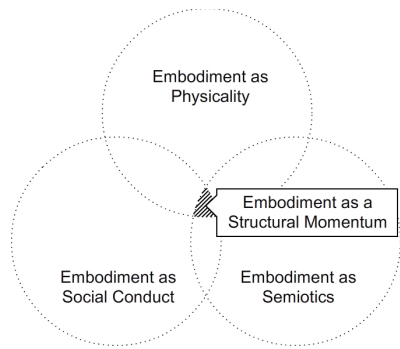
General Terms

Theory, Design.

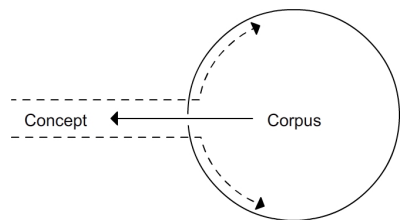Fig. 1: Overlapping positions of embodiment in the literature.

Fig. 2: The phenomenon of embodiment as a structural momentum: A two-way relationship between a concept and a corpus.

Introduction

The concept of 'Embodied Interaction' is of growing interest in the HCI community. However, the term itself and the underlying concept of embodiment are not used consistently. As a basis for my argument, I will briefly outline the different positions of viewing embodiment that are currently existent in the relevant literature.

Embodiment as Physicality

A *physical* notion of the Embodiment term can be found across various positions in the literature, e.g. in works of Ishii [7] and Dourish [1]. In his paper 'Tangible Bits', Ishii criticizes the non-physicality of then-prevalent computing: 'GUIs fall short of embracing the richness of human senses and skills people have developed through a lifetime of interaction with the physical world.'. Dourish's assumption is that Embodiment is 'a phenomenon underlying the ideas of tangible and social computing'. He defines embodiment as 'possessing and acting through a physical manifestation in the world'. However, he later extends this definition beyond the physical.

Embodiment as Social Conduct

Dourish adds social and generally 'practice-based' aspects by defining embodiment as 'phenomena (…) those that by their very nature occur in real time and real space' [1]. He also relates to Suchman's work [10] about activity 'beyond the human processor model' as a motor for the further development of HCI.

Fallman distinguishes between two roles of the body, a 'experiential' role, and a 'cultural' role [2]. To the threefold relation between human, technology, and world, Fallman notes: '[It] cannot solely be thought of as a set of physical properties, but that world rather implies involvement in a particular setting, which conveys both physical and social structures of meaning.'

Embodiment as Semiotics

Recently, O'Neill [9] picked up on these works and presented a semiotic approach. Following on Nadin's semiotic analysis [8], he integrates 'Phenomenology, semiotics, cognitive psychology into a new theory', bridging Gibsonian, Heideggerian, and Peircian concepts into the notion of 'Being-with-Media'.

Embodiment as a Structural Momentum

The aforementioned literature appears not to be sufficient as to clarify *what embodiment is*. Rather than that, the term appears blurred and is not used distinctively at all. This work aims to offer clarity by viewing a broader version of the embodiment notion: A purely structural interpretation.

Heidegger's writings around 'Being and Time' are particularly fruitful for such an argument (Fig. 1), as he *avoids* the notions of 'physical' and even 'human', referring only to structural momentums. What he describes is merely interplay of *concept* and *corpus*. The difference between these is that concepts are *abstract*, and corpuses are, while not necessarily physical, *concrete*.

Heidegger does not use the term 'Embodiment' directly, but he refers to *Dinglichkeit,* the structural momentum (Fig. 2) of concrete entities: *Dinge* (πραγματα, pragmata) – *Things*.

Fig. 3: The 'Dynamic Knobs' prototype.

Fig. 4: The 'Ambient Life' prototype.

Heidegger argues that Being-in-the-World, and coping with things is constituted through a number of concepts. Besides the often-used concepts of *Vorhandenheit* (presentness-at-hand, or occurrentness) and *Zuhandenheit* (readiness-to-hand, or availableness), he analyzes, among others, the concepts of *Substanzialität* (substantiality*)*, *Ausgedehntheit* (extendedness), and *Nähe* (proximity).

In what does it help one to concern Heideggerian philosophy for the design of interactive systems so broadly and abstractly?

In a great portion of Heidegger-influenced literature, only the concepts of occurrentness and availableness are used to classify the dealing with interactive systems. However, I would like to argue that Heidegger has more than that to offer: A classification system for *Things*.

Having moved out of the topic to such a wide term, we can now create taxonomies of embodiment on an abstract level, one that is rarely present in the literature. The conceptual relationships Heidegger presents are general, and therefore versatile – but putting them into practice is can be a challenging undertaking.

Theory meets Practice: Projects
This work also contains tangible contributions to the HCI community. The prototypes I have built allow for the experience of new interaction styles, drawing on the specific skills of the human hand. While not directly derived from theoretical thoughts at the time of their creation, this work will, in reviewing the relevant literature, provide the conceptual reference points.
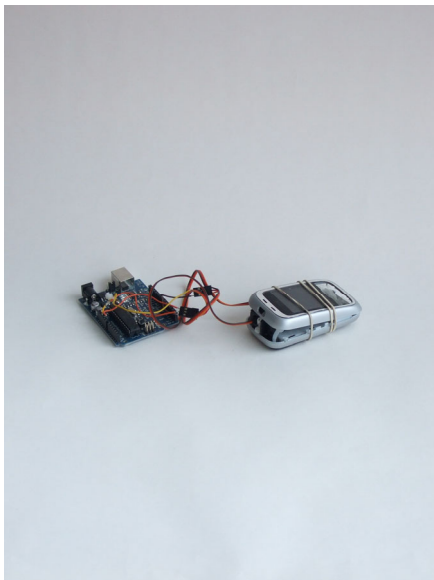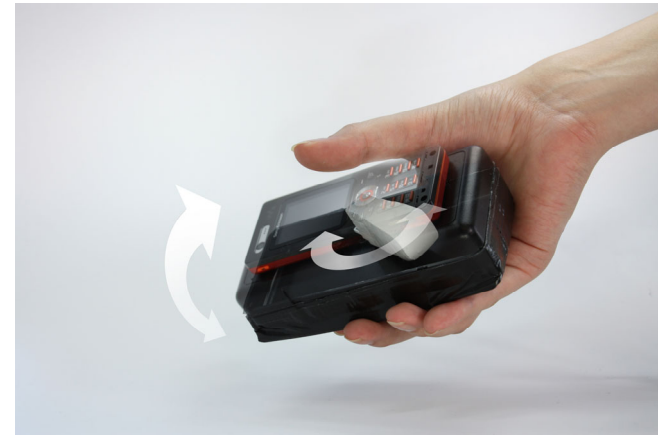

Fig. 5: The 'Weight-Shifting Mobiles' prototype.

Extendedness
In the Dynamic Knobs project, it was investigated how shape change could be used as a means of interaction. The palpability of *information* as *deformation* was investigated through a tangible, force-feedback enabled mobile phone prototype (Fig. 3) [6] .

Proximity
In the Ambient Life project, the proximal relationship towards a mobile phone was exaggerated, through the simulation of 'living' in a mobile phone. Utilizing a soft tactile heartbeat and breathing motion, the phone created a sense of 'closeness' for its user (Fig. 4) [4].

Substantiality

The Weight-Shifting Mobiles project proposed the usage of shifting weight inside a mobile phone for permanent, directed actuation. In doing so, it provided the data stored on the mobile phone a substantial manifestation: More data on one side of the display was physically manifested in a greater weight of the phone on that side (Fig. 5) [5].

Reflection: Interfaces beyond the Surface

This roughly outlines the course that my work took during the last years. Shape-changing (extendedness), continuous tactile presence (proximity), and weight-shift (substantiality) – all these do happen at the device's physical surfaces, but they, as opposed to visual media, allow for rich and – physically – connected interaction. This work argues for a movement towards a non-visual style of interface design that happens beyond the surface.

I believe that a structural approach to Embodiment can help designers to envision such new forms of embodied interaction. They may be physical, or simply arise from social conduct, or be entirely based on semiotic principles – an abstract, structural perspective, for which Heideggerian literature can serve as a starting point, could hold them together.

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