# How it Feels, not Just How it Looks: When Bodies Interact with Technology

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**ABSTRACT**
This paper presents thoughts to extend our understanding of bodily aspects of technology interactions. The aim of the paper is to offer a way of looking at the role our kinaesthetic sense plays in human-computer interaction. We approach this issue by framing it around how our bodies establish relationships with things when interacting with technology. Five aspects of a conceptual tool, *body-thing dialogue*, *potential for action*, *within-reach*, *out-of-reach* and *movement expression* are introduced. We discuss the role this tool can play in our thinking about, further exploration and eventually our design for movement enabled technology interactions. The idea is that it can help us consider, not just how a design or a technology might look but also how it might *feel* to use.

**Author Keywords**
Body, Embodied, Interaction, Interaction design, Kinaesthetics, Movement

**ACM Classification Keywords**
H.5.2. [User Interfaces] Ergonomics, Interaction Styles, Theory and Methods, User-centered design.

## INTRODUCTION

Gibson states that the world unfolds itself in possibilities for action (1986). We perceive the world in relation to what we can do with it. Thus, the world is inherently meaningful for our body and by moving we can gain access to that meaning.

Our interactions with technology are primarily visual, and to some extent also auditory and tangible. Graphical user interfaces (GUIs) rely heavily on one or more of these modes of interaction, so when we close our eyes, block our ears, shut our mouths and withdraw our hands in front of a GUI, the interactive dimensions seem to collapse. Though, to quote Buxton (1986), "there is more to interaction than meets the eye". The *feel dimension*, the kinaesthetic dimension of human-computer interaction (HCI) is rarely explicitly considered in the study of technology use and we believe it is underutilized in technology design. (Note: we use the terms proprioception and kinaesthetic sense interchangeably, when referring to the sense that allows us to know our body position and the movement of our limbs.) In this paper we attempt to address how we can understand this *feel dimension* from an embodied view, and indicate some implications for interaction design. We are not discounting the importance of the visual sense, but it is not the focus here.

The paper is structured as follows. We begin with a brief overview of embodied perspectives and kinaesthetic approaches in HCI and interaction design. This is followed by an explanation of the way we understand the body's role in perception; this section introduces the ideas necessary for us to present our conceptual tool in the subsequent section. We conclude with a discussion of its implications for interaction design.

## EMBODIED APPROACHES TO HCI

Embodied approaches to HCI are not new; the thinking presented in this paper builds on work by phenomenologically-motivated researchers such as Robertson (1997, 2002), Dourish (2001) and Hornecker (2006) to name just a few. Kinesthetic dimensions of interaction design and HCI have been treated explicitly by Svanæs (2000), Schiphorst and Andersen (2004) and Moen (2006). Djajadiningrat et al. (2000) offer a perspective from product design that advocates a focus on designing for user experience rather than ease of use and visual aesthetics. Embodied approaches to studying, conceptualising and designing for the lived body are set against a rapidly increasing number of prototypes, concepts and applications that use movement to enable interaction or that use movement in different ways. These technologies rely on a range of sensors such as vision-based techniques, pressure, motion, position/proximity and accelerometer type sensors to enable input through movement. For research that discusses aspects of technology design from the point of view of sensors, see e.g. Benford et al. (2005) and Rogers and Muller (2006). We offer a complementary view; our starting point is an explanation of our understanding of the human body's integral role in human action with reference to how we perceive our physical selves in space and how we perceive when acting through tools.

## THE MOVING, PERCEIVING BODY

When we sit, stand, reach for our mobile phone when it rings, or run to catch the bus, it is sensory information

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that guides our movement. Action directs *perception*: we move our fingers to touch; we turn our heads to catch a sound or to see. Merleau-Ponty said that vision is the brain's way of touching (1962); as well, we could say that touching is one way the body sees. Sensing and motor skills are in constant dialogue, performing in concert. The organisation of our movement patterns depends upon our habits of perception.

**Proprioception**

While we see, touch and hear the world around us, there is also an ongoing process of locating ourselves from inside. Dance theoretician Laban talks about the kinaesthetic sense this way *"...the sense by which we perceive muscular effort, movement, and position in space. Its organs are not situated in any particular part of the body, as those of seeing and hearing..."* (1988, p. 111). This is also manifested as a sense of our weight and perceived boundaries defined by where skin meets world. These sensations from "within" make up the "somatic self", telling us where we are and where we end. Damasio (2000) has suggested that a large part of what allows us to feel like the same person from day to day is the sameness of these signals from the body day after day; "somatic markers" tell me that I am still "me". Many of us have only a vague sense of our bodies on this level. However, proprioception can be cultivated to gain an appreciation and awareness of this "inner" sense.

**Spatial Perception and Use of Tools**

Locating ourselves in space is another side of the physical sense of our bodies. Using primarily sound and vision, we orient ourselves to the world around us. Using our physical sense of our bodies as our point of reference, we construct the spatial relationships we perceive. This is the boundary where our "inner" world of perceptions meets an "outer" world. Using our spatial perception, we are aware of our bodies as an object among other objects. When we reach down to scratch a knee, we act within the spatiality given by our bodies. When we reach over to press the 'on' button on a laptop we act within a space given by the relationship between our bodies and the action we want to perform, i.e. turn the laptop on. Our spatial perception, hence our bodily space is constituted by our *potential for action* in the world.

Tools extend our potential for action emerging from our interactions with the physical world: a tennis racket becomes an extension of the hand, and a car becomes incorporated into our bodily space. In skilled handling of a tool we are absorbed in our activity and the tool exists to us as part of the activity. However if something changes or the activity is interrupted, e.g. we hit the tennis ball off centre in a serve; our focus reverts back to dealing with the tool rather than being fully engaged in our activity.

## FEEL DIMENSION OF TECHNOLOGY INTERACTIONS

The *feel dimension* of technology interactions is how we use our proprioceptive sense and motor skills when incorporating a tool into our bodily space so that it becomes an extension of our bodies. The conceptual tool introduced here has five aspects: *body-thing dialogue*, *potential for action*, *within-reach*, *out-of-reach* and *movement expression*. It is intended as a tool that might provide us with ways to come to an understanding of the *feel dimension* of technology interaction. The five aspects are all interrelated, aiming to address different aspects of the *feel dimension*. Each one is elaborated below with examples and explanation of their implications.

**Body-Thing Dialogue**

In order to isolate the *feel dimension* within the body, try to imagine that the kinaesthetic sense is our only sense modality. To perceive or experience anything we have to move. Further, if we do not know what kind of body we have, we have to move to discover this as well. To perceive, we have to act. To perceive is to act. In a world where the *feel dimension* is our only sense modality, aspects of technology interactions are now based around what happens when our bodies couple with things, (note: we have deliberately chosen to use the non-specific term *thing* because we want to refer to non-specific objects). In the process of incorporating things into our bodily space, there is a *dialogue* between our perception and the thing, which is enacted as a change in our potential for action. In this dialogue we are monitoring what it feels like for the body to do what it is doing. We are trying out different feelings and evaluating the effect of these as actions in the world. The *feel dimension* of technology interactions is this ongoing dialogue. It is a dialogue where movement is the mode of communication. In a movement dialogue there is an encounter of a willing mover and an inviting space in which to move.

The experience is an interplay between our bodies and the world available to us, where our bodies are engaged in a dialogue with the thing, allowing and enabling certain *potentials for action*. The ways in which a thing allows coupling (or not) are described as *within-reach* and *out-of-reach*, while *movement expression* talks about the movements used in the dialogue.

Some keywords for this aspect: dialogue, coupling, enabling.

**Potential for action**

*Potential for action* is made up of what we want to do and the kind of body we have. Different bodies have different sets of movements available to them in relation to a thing. People's movement possibilities are based on their bodies, experiences and skills. Factors such as different types of clothing, use of tools, the setting one is in, also give rise to different movement possibilities and hence different potentials for action. When we move in a body-thing couple, we couple our movement possibilities to the thing's movement possibilities and feel the consequent change in our potential for action. When we move freely (e.g. dance) we can feel only our own movement possibilities. When we move in relation to a thing (e.g. play an instrument) we can feel properties of the body-thing couple, we can also feel properties belonging to the thing, as well as our own movement possibilities. For example, if given a bat, a person rugged up to cross

the South Pole and a person on an Australian beach, would have different movement possibilities.

Some keywords for this aspect: bodies, movement possibilities, skills.

### Within-reach and Out-of-Reach

The ways in which a thing allows itself to be coupled with (or not) give rise to the next two aspects, *within-reach* and *out-of-reach*. These are not to be taken in a purely physical sense; the *feel dimension* of technology interactions is based on whether the actions are having the desired effect in the world, not only in terms of being within-reach or out-of-reach in a physical sense. An interaction can be out-of-reach due to *physical constraints* (e.g. shape, weight etc) or *cultural/social constraints* (e.g. inappropriateness).

#### *Within-reach*

Interactions taking place *within* bodily *reach* are characterised by the fact that they are taking place on, near or fairly close to the body. Examples could be tangible interactions such as moving tagged objects in an augmented reality environment, moving a can of beans with a RFID tag near a cash register or skipping to the next song on the MP3-player in our pocket. Within reach interactions are also those that would not normally be possible, but that are enabled through the use of another thing (e.g. a crane to lift a container), or interactions that would be understood in a certain context (e.g. a gesture to a sensing system). The commonality is that the thing allows us to couple our movement possibilities with the thing's possibilities and have the desired effect in the world.

Some keywords for this aspect: proximity, position, reach.

#### *Out-of-Reach*

Interactions that are *out-of-reach* are out of reach either due to physical constraints (e.g. sliding door), cultural/ social constraints (e.g. self-flushing toilets) or both (e.g. technology's lack of understanding of context). These are interactions which tend not to have tangible elements. They depend on a user's position and/or location sensed by either stationary or moving technology located in the environment. Positioning is an important aspect to out-of-reach interaction. In a museum with an audio tour, trying to find the position to trigger the correct recording can sometimes be a challenge and take up more attention that looking at the exhibits and listening to the recording.

Some keywords for this aspect: distance, position, situation.

Technology interactions can consist of both tangible and non-tangible elements. In relation to the *feel dimension* there is a distinct difference between things we can touch and those we can not touch. Things we can touch can be experienced and hence interacted with in ways different from those we can not. This is because with things we can handle we can couple our potential for action with the thing's movement possibilities and feel the subsequent change in our potential for action. A thing that we cannot couple with provides less information about its, and therefore our potential for action, through the *feel dimension*. Whether something can be touched or not might seem to be the major difference between the *within-reach* and *out-of-reach* aspects. It is not, the difference lies in whether our actions are having the desired effect in the world. If no coupling is possible, there is no room for us to engage in the dialogue to establish the body-thing couple. In an out-of-reach interaction the thing then needs to provide additional sensory information to compensate for this.

The experience of coupling our potential for action to a thing's movement possibilities through touch is what Merleau-Ponty's (1962) talks about when he says that our hands are both touching and being touched at the same time. In the body-thing couple, only the body is a perceiver, but it perceives both touching (i.e. what is my potential for action and my movement possibilities as a body-thing couple), as well as touched (i.e. what is the potential of this thing). The reason we can perceive both touching and being touched is the bilateral nature of the kinaesthetic sense.

### Movement expression

*Movement expression* refers to the way in which we execute a movement to establish a coupling in an interaction, whether the interaction is happening within-reach or out-of-reach. For example, when interacting with the SONY Playstation2™ Eyetoy® the way in which a movement is executed does not matter (Loke et al., 2006). In this system, this is an advantage as it allows people to interact with individual movement expressions. A kiosk with a touch screen in a public space should be designed so anyone can walk up to it and start using it. However, systems which will be used over extended periods of time and require some effort to learn could be designed to capitalise on individual movement expressions. To our bodies, the way in which a movement is executed always matters. There is always an intentional purpose for our movements for perception. To technology, movement expression matters only sometimes. Whether it matters for individual projects should be based on considerations such as tasks, target users and context of use. However, the degree to which movement expression in technology interactions should be choreographed is a significant ethical issue which needs to be considered carefully by technology designers.

Some keywords for this aspect: space, time, weight.

## CONCLUSION

In this paper we have presented a way of looking at the *feel dimension* of technology interactions. We have described it as particular kind of dialogue between bodies and things.

To design technology interactions that address the *feel dimension* as well as the other human senses, we suggest that technology designers consider how their design might impact on *body-thing dialogue*, *potential for action*, *within-reach*, *out-of-reach* and *movement expression*, as well as thinking in terms of *ease of use*.

Designing for the *feel dimension* is inherently ambiguous; people have different potential for action as different bodies have different movement possibilities. However, an awareness of this diversity opens up a design space where we can think in terms of giving the body an inviting movement problem to solve or explore, in order that a user can achieve what s/he wishes with that technology.

Our focus on the *feel dimension* is not intended to reduce human interaction with technology to the kinaesthetic sense alone. The *feel dimension* would not be isolated in lived experience. Our different senses make available the worlds in which we can act, but they are not reducible to each other. Each sense immerses our bodies in our worlds in different ways. Our intention has been to look at the specificity of the *feel dimension*, because it is different from the much better understood visual dimension. We see it as an area of HCI which has received insufficient attention, but it is becoming increasingly important due to emerging technologies. The *feel dimension* allows us a fuller understanding of user experience by focusing not just on how it looks but also on how it might *feel* to interact with technology.

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