BodyBug – Design of KinAesthetic Interaction

Aesthetic aspects of interaction have become a well-discussed issue. In this paper we present some early results from an ongoing doctoral project focusing on exploring the area of full body movement interaction and in particularly what we call "kinAesthetic interaction". The paper refers to an empirical study that aimed at exploring the area of bodily movements as interaction modality from a user centred perspective, and from this extracting important aspects that should be taken into account when designing movement interaction. We also present a prototype called BodyBug that has been designed and developed in order to exemplify movement interaction, based on design implications brought up in the empirical study. Implemented aspects reflect the experience of learning to sense and feel one's own body and movement pattern; the diversity in different peoples' body language; as well as the aesthetic experience of being able to feel flow and harmony when moving.

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INTRODUCTION

Design is an aspect that has become more and more influential in several disciplines, from education to human computer interaction. The everyday use of the word design does often refer to the shape or visual appearance of a product, and thus the aesthetics of it. Today the aesthetic aspects of everyday life are often emphasized. People representing various disciplines are talking about the society as "aestheticalized", and expressions as "aesthetic practices" and "aesthetic interaction" are well used. This paper presents some early results regarding the notion of aesthetic movement interaction in the area of human computer interaction design.

Figure 1: BodyBug creates kinaesthetic interaction.

When it comes to interactive systems, the notion of aesthetic interaction has recently been related to the aesthetics of use rather than the aesthetics of appearance [8]. There is also a discussion going on regarding the aesthetic experience of the interaction [3]. However, introducing and designing for these interaction aspects demand new skills of the designers, i.e. a sensitive empathic understanding of the interaction design, as well as creative skills in order to be able to implement these issues. A previous study shows that these skills can be developed when introducing movement into the design education [7].

The ongoing doctoral project referred to in this paper, uses a similar pedagogical methodology, i.e. providing prospective engineers and interaction designers, with self experienced movement explorations and artistic dance-related work, in

order to develop their sensitivity to and knowledge of movements as an interaction form. Furthermore, it consists of a design case of movement interaction (see Figure 1) based on implications arisen through exploring natural human bodily movements, and thus exemplifies a holistic perspective on the design process.

BACKGROUND

Embodied Movement Interaction

Embodied interaction in the meaning of visually representing the user with a bodily and physical appearance has been used in social virtual environments for a long time. However, in recent years the expression has become a well-used term in human computer interaction related areas where the physical, tangible, ubiquitous, and emotional interaction aspects are emphasized [2].

When making use of several interaction modalities, one issue that arises is what each modality contributes to and what it reflects. Physical movements have become more and more used as means of input and interaction form, both in commercial game applications, and artistic installations and artworks. This could be seen as a natural development after text and speech-based interfaces as well as striving towards including the whole human body when interacting with computers and technology.

However, a lot of today's movement based interactive applications might be called technology driven. When the interaction is designed on the basis of and with the starting point in the technology available, it could result in limited interaction possibilities and decreased design spaces. From a user centred perspective it is desirable to take the starting point in the human being and her needs, as well as her natural behaviour, rather than the technology.

KinAesthetic Interaction

So, why is it interesting and important to use bodily movements as means of interaction?

Haptic interaction, i.e. perception through the sense of touch, is directly connected to bodily movements through the kinaesthetic information from muscles, tendons and joints, as well as tactile information from nerve cells, etc. Accordingly, there have been developed several interaction devices in order to support this kind of input and output. However, this project focuses on using the body itself as the full-scale haptic display it is rather than developing new kinds of interaction devices.

As previously mentioned, the focus in human computer interaction has shifted from interface design towards the design of interaction experiences and aesthetic interaction. Using our own physical movements in order to communicate whether it is with computers and technology or other human beings, creates a direct bodily experience. The body through its senses is the holder of both cognitive processes and emotions. Thus using the whole body when communicating gives the user a physical and an emotional experience of the interaction [10].

EMPIRICAL STUDIES OF MOVEMENT INTERACTION

In order to more or less unprejudiced explore the area of movement interaction from a user centred perspective, an empirical study that aimed at taking the starting point in natural human movement interaction was carried out [6]. The method used took an ethnographic approach in the way of looking at the field of movement exploration [1].

The informants used were participants on a course called Physical Expression that was carried out throughout thirteen weeks during spring 2004. The course was given as an eligible course at the technical university, and all participants were either studying or working in areas related to human computer

interaction or interaction design. Research data were collected through multiple interviews with each participant; reflective texts written by the participants; as well as videotaped and observed course lessons and workshops.

Figure 2: Participants on the course Physical Expression when exploring bodily movement impulses.

The course consisted of movement training based on modern and contemporary dance methodology with emphasis on improvisation, quality of movements and creative work (see Figure 2). It was taught by a dance teacher and took place in a dance studio, although the mirrors were not used in order to focus on the kinaesthetic and three-dimensional experience of the activities. Furthermore as part of the course, two design workshops that aimed at bridging the physical movement exploration and human computer interaction design were carried out.

Exploring Movements

One perspective of movement interaction that came out of the empirical study was the experience of sensing and feeling the body, on a physical level but also as an aesthetic experience. One informant expressed that "…you have this picture of the petite girl that dances so nice. And that is why it is so cool that I can feel pretty even if I think that there is far between my own fingers and toes".

Despite her ordinary self-impression of being tall with a bushy body language, and normally moving like a "fridge", the informant had been able to feel beauty and harmony in her movements. She expressed that the experience of feeling good when moving was strongly related to the movement pattern, as "…it must be different movement patterns that suit us better". Feeling harmony and flow when moving did also make the participants "become themselves" as they were moving according to "their own frames".

Another important insight the informants expressed was how different and specific each person's body language is. Through the exercises they got to know and sense their own body language as well as watch and try out other participants' bodily expressions. One informant expressed that "…I have in some way come to an understanding of how I move. I have understood where my limits are, and I have tried other ways of moving. But I do not think that I have actually changed my own way of moving."

Several informants pointed at the importance of personal limits, integrity and intimacy when using the body as a communication tool and when interacting with other people or machines. However, these limits varied depending on with whom and in which context they were interacting.

IMPLICATIONS FOR INTERACTION DESIGN

Some of the central issues of movement interaction that arose were: the experience of sensing and feeling the body; learning to know one's own body language and movement pattern; differences in individual body language; and aspects of integrity, intimacy, flow and harmony in relation to movements and interaction. Consequently, we wanted to preserve these aspects in our interaction design. One of the first questions that seemed obvious was: is it possible to use bodily movements as interaction input and output, and in what kinds of applications is this interaction modality appropriate? In this project one aim has been to work explorative and unprejudiced, and keep the interaction modality in focus rather than prospective applications areas. Continuing along this path, the discussion has concerned which perspectives of the interaction experiences should be supported, rather than which functions should be implemented, i.e. designing the interaction experience before the application.

When using movements as interaction modality one could say on basis of the study, that it is important to give room for individual differences, both in physical size and in movement pattern. In order to create a pleasurable and user-friendly interaction experience, the movements required should be quite similar to the users' natural body language. This means that the interaction should support diversity rather than convergence, e.g. that different kinds of input or ways of giving input might give the same output. As the body language is very individual and personal, the interaction possibilities should provide individual means of expressing oneself.

Furthermore, the movement interaction should support the sensation of the body and the experience of one's own movement pattern. As being kinaesthetic interaction, the focus lies on the physical sensations rather than visual experiences, which implies that the interaction could be performed with closed eyes or blindfolded. In other words, the interaction should be based on haptic cues, i.e. cues sensational by the sense of touch, both for input and output.

BODYBUG AS DESIGN EXAMPLE

When working with implications for interaction design it is important to implement the theoretical results into practical examples in order to provide people with the possibility of a personal experience of the issues concerned. The actual work of designing and developing an artefact do also force the designers to reflect on the work done and clarify important aspects of the artefact being designed [4].

The design implications produced in this project have been made concrete and physically exemplified by implementing an interaction concept and prototype called BodyBug. The concept was collaboratively designed and developed by the authors during fall 2004. A first working prototype was presented in January 2005 and a second version was finished in April 2005 (see Figure 1 and 3).

Making BodyBug

The design process of what became BodyBug started out by a two-day concept design workshop that also was the starting point for the interaction designer's participation in the project. However, we had prior to the workshop identified a common interest in movement interaction, based in our different backgrounds and competencies, i.e. interaction designer and dance teacher/engineer. Johan had previous experiences of developing prototypes for movement interaction and expression [9] and Jin had previously been working with haptic interfaces as well as carried out the empirical study already mentioned. During the concept design workshop we experienced that our dissimilarities served the design process

well in how it contributed to different ways of thinking and working [5].

During the concept design workshop, experiences from the empirical study were preserved through extensive discussions of notions as flow, balance, sensing the body, personal space, movement impulses, individually differences, etc; but also through watching videotapes from the dance classes. As a result of this work we came up with a few important aspects that we wanted to reflect in the interaction concept, e.g. to initiate and trigger (new) movements; include the whole body when interacting; and give room for personal ways of interaction.

Figure 3: Collaborative interaction using BodyBug.

Methods used in the development process were extensive concept sketching and rapid mock-ups, working towards a fully functional prototype. One early-established goal were to design a context and place independent gadget without any specific functionality and application area, something portable and mobile, like a wearable or jewel. However, the aim of making the artefact was to introduce movements as interaction modality and thus providing possibilities for personal expressions and novel user experiences.

For the physical appearance of the object we made some basic criteria. The object's form was set out to be every-day, neutral and robust, in order to create a design that would not limit a creative use. Our intention was to avoid expressions such as fragileness, exclusiveness and customization, as well as adaptations to specific contexts or fields of application. The quality of the object's interaction and expression, i.e. input and output, aimed at being 'quick and compact'.

The Movement Interaction Concept

In order to summarize and describe the resulting interaction concept called BodyBug, we made a statement that aimed at reflecting what we had intended to make:

> "BodyBug is a climbing gadget that makes use of bodily movements in order to create a physical dialogue between the wearer and the machine. When you feed BodyBug with movement impulses it will move along a path that is placed on your body. Depending on how you move, BodyBug will respond to

you in different ways. BodyBug could be used in optional contexts and in optional ways in order to support your own personal expressions and impressions."

In other words, BodyBug could be described as a robotic unit running on a plastic covered wire. The wire is provided with Velcro in both ends, which are used for attaching BodyBug onto the wearer. When the wearer starts to move the body, and thus generates movement impulses, the unit will start to move as well, depending on the characteristics of the impulses. In order to keep the unit in motion, the wearer should continue to move and generate appropriate movement impulses, an interaction concept similar to the well know toy hula-hoop. However, the movements needed are not explicitly defined and therefore several kinds of movements or ways of moving could be used. Hence, it is the wearer that defines the exact use of BodyBug.

Implementation

The implementation of the prototype was not based on any preset fixed specification, but rather as an ongoing discussion between the participants, on how to best preserve the design implications and intentions of the work. We strived towards respecting the overall goals as carefully as possible in every design decision.

As the aim of this project was to create novel interaction experiences rather than forcefully make use of new and untried technologies, we looked for technical solutions that served our interaction concept well. It turned out to be the mechanical solution that became our greatest challenge, as we wanted to work with a small sized object. Sticking to our limited budget and time schedule, we were forced to introduce more competence into the project. We came up with a small but yet flexible construction that served well for the purpose of user testing.
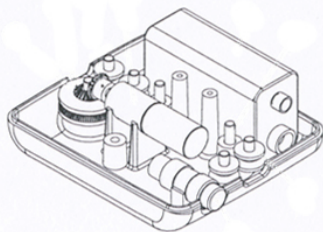
Figure 4: Inside BodyBug: mechanics, motor, battery and switch (circuit not showed).

The physical construction consists of a unit that runs on a plastic covered wire. Inside the unit there are sensors that capture the bodily movement impulses and transform them into motion of the unit, using a small DC-motor (see Figure 4). The wire-mount consists of aluminium gear wheels and plastic wheels. The casing of the unit is made using a Stereo lithography (SLA) prototyping technique, where plastic are fixated using laser. The unit is powered with batteries.

CONCLUSIONS AND FURTHER WORK

Applications such as BodyBug may serve as inspiration for further exploring physical aspects of computer use, using motor skills developed during the interaction, rather than relying on memory or visual cues. The prototype is versatile

object that can be used for simple play and leisure, as a game or a social activity, as well as a way of personal exploration and expression. Furthermore, it may turn the focus on the body's role when designing computational objects, as it aims at including the whole physical body as well as thoughts and emotions.

The design process of BodyBug also shows that it was possible to preserve issues concerning qualities of bodily interaction that came up during the dance course, in the design of the prototype. As previously mentioned, interaction experience studies of BodyBug will be conducted during spring 2005. These results will be included in the doctoral thesis of the author, and thus contribute to the further discussion on using movements as interaction modality within human computer interaction design.

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