How to Assess the User's Experience in Cultural Computing

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Abstract

In this paper I start with an overview over the different paradigms emerged over the last decades in HCI. I introduce the paradigm of cultural computing based on concepts like Kansei Mediation. It is an ambitious challenge to compare Eastern and Western cultures.

One of the main challenges will be to measure the user's experience, in particular for sub- or even unconscious cognitive and body functions. An overview of already available measuring approaches is provided, and some preliminary conclusions are drawn.

Keywords

User Experience, Cultural Computing, Unconsciousness, Kansei Mediation

1.0 Introduction

Nowadays, developing a new product or service means being creative and taking risks to explore new opportunities provided by upcoming technologies. But before any particular semantic could be mapped to a new syntactical form, we have to explore this syntactical design space first. Combining all kinds of new materials and advanced technology is part of the established engineering research agenda. Given new syntactical interesting combinations the next step is investigating possible meaningful mappings of functionality (i.e. semantics) to these new forms. This is part of the research agenda of interaction design. But at the end to launch a successful product or service on the market these new combinations of form (i.e. syntax) and functionality or content (i.e. semantics) have to be embedded in the behavioral interaction pattern of the customers (i.e. pragmatics).

We assume that functionality or content (i.e. semantic) can not exist without a predetermined form (i.e. syntax). Although this assumption is debatable, we still think it is quite useful for the following discussion. We can distinguish six different situations to explore each level (i.e. syntactic, semantic, pragmatic) and to investigate the mappings between them (see Figure 1, (a) … (f)). In situation (a) we only explore the syntactical level and try to find stabile or at least interesting combinations of new materials and/or electronics.

The difference between situation (b) and (d) is that (b) is a useless mapping and (d) is a useful mapping of semantic to a new form. Usability testing can help to distinguish between both situations. In situation (c) a company wants to introduce a new product or service on the market (i.e. pragmatic) and fails due to an inappropriate mapping between syntax and semantic. In situation (e) such kind of 'failure' can be repaired by intensive marketing and advertisement to extend the scope of the pragmatically level. Only situation (f) guarantees without out extra effort a successful introduction of a new product or service on the market. User centered design increases the chance for achieving (f) (Overbeeke et al, 2002). In this paper we describe our preliminary results somewhere between situation (d) and (e).

2.0 HCI: upcoming paradigms

Human-Computer Interaction (HCI) has evolved over more than five decades. Although the history of HCI is rich and complex, within the scope of this paper we will summarize some of the major paradigms that are: (1) personal computing, (2) cooperative computing, (3) social computing, and (4) cultural computing (see Figure 2). The history of HCI goes back to the 60s. Originally it was about Man-Machine Interaction and the emergence of the Personal Computing (PC) paradigm. In the 80s, HCI was investigating media rich computing with the paradigm of networked computer mediated interaction. Interactive multimedia was the focus of attention. More
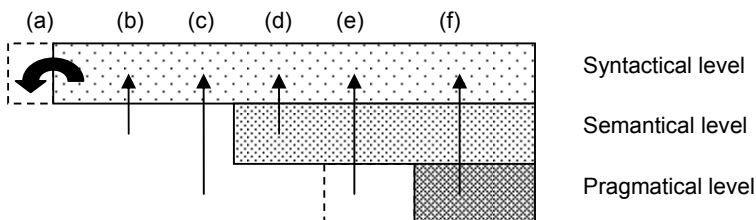

Figure 1. The three different levels of a product development process: from syntax to pragmatics.

recently, at the turn of the century, HCI was about the social computing paradigm with community mediated interaction. The HCI community investigated applications such as Computer Supported Cooperative Work (CSCW), and the Internet (e.g., on line communities). With mobile, portable and ubiquitous technology, HCI is looking at more personalized and intimate interaction with positive experiences. Several concepts have emerged in recent years for the future directions of HCI: ubiquitous, nomadic, mixed-reality computing, and so on. In general all these new directions have some common properties: (1) the disappearing computer; (2) the ease of use and positive experience and; (3) the building of communities. The computer is no more the centre of interest, nor is it the focus of attention of the user. It is the running applications and the benefits and effects these have on the user that matter. Finally, Nakatsu, Rauterberg and Salem (2006) propose as a new paradigm for HCI, cultural computing which is based on what we call Kansei Mediated Interaction. Kansei Mediation is a form of multimedia communication that carries non-verbal, emotional and Kansei information (e.g., unconscious communication). Kansei Mediation is a combination of Kansei Communication (i.e., 'content') and Kansei Media (i.e., 'form'). The main research objectives in Kansei Mediated Interaction are the underlying almost unconscious cultural determinants (see also Hu & Bartneck, 2005; Salem & Rauterberg, 2005b).

Although the cultural dependency is somewhat a drawback it has many advantages. Cultural computing allows for a much richer experience to be rendered (e.g., Pierce et al, 1999; Tosa et al, 2005; Nakatsu et al, 2006). This is caused by the complexity and depth of the semantics involved. There is also the advantage of higher bandwidth of information at the interface as symbolic meanings, implicit knowledge and subliminal perception can be used. The interface is not limited to explicit messages and meanings. However, there is a challenge in finding culturally rich media that could be used to deliver cultural experience. One of the major points of this approach is the proposal and intent to rely on Kansei Mediation as a mean to deliver the necessary media and bandwidth rich interface.

In essence Kansei Mediation is about exchanging cultural values efficiently and effectively. Kansei Communication is about sharing implicit knowledge such as feelings, emotions and moods. Kansei Media are the channels used to do so, such as haptics, voice tone and other non-verbal communication. The integration of multiple, multimode and Kansei Media can enable a type of interaction that is neither biased towards cognition, nor biased towards awareness. This is what we call Kansei Mediated Interaction. Several [un]conscious cognitive and body functions can be ordered according to their life-span. Kansei Mediated Interaction has the potential to stimulate and influence most of these functions. The mainly unconscious cognitive and body functions that have an influence on the *Presence* experience are: reflexes, sensations, thoughts, dreams, emotions, moods, and drives.

3.0 Measuring the User's Experience

While unconscious experience (e.g. subliminal perception) is a valid phenomenon, recent research has shown that it can only be measured under certain carefully controlled conditions. These include the establishment of individual thresholds for each user, a controlled viewing environment, focused attention on specific areas in the perceptual space, and exclusion of extraneous sources of stimulation.
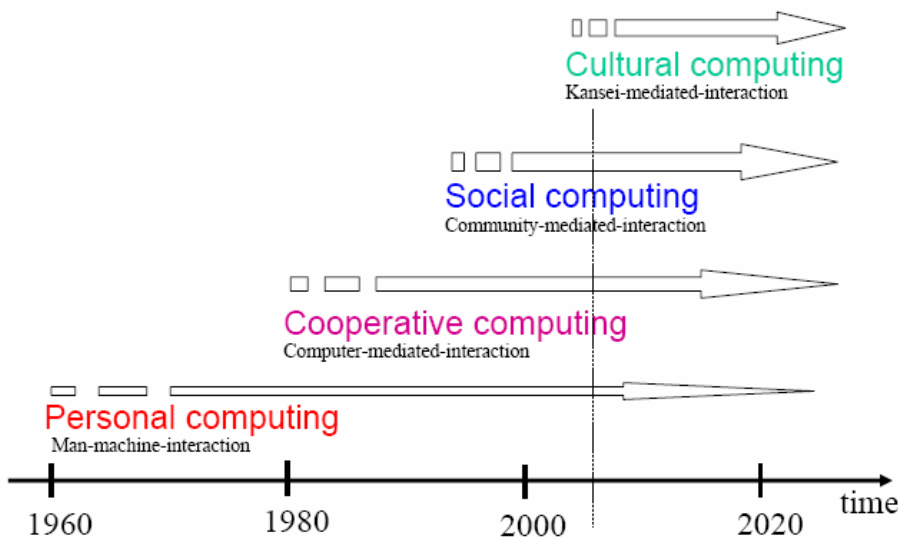

Figure 2. From Personal to Cultural Computing, an overview over the most relevant interaction paradigms.

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Most important is the finding that subliminal perception is most appropriately defined as a situation in which there is a discrepancy between the users phenomenal experience, and their ability to discriminate between different stimulus states. Users are often sensitive to stimuli they claim not to have seen. When required to distinguish between two or more stimuli, users can do so with some success, even while professing to be guessing (Holender, 1986). On the other hand, there is little reliable evidence of semantic processing of stimuli which cannot be discriminated (Cheesman & Merikle, 1984; 1986).

According to Merikle and Reingold (1992) the available evidence suggests that subliminal perception is not perception in the absence of stimulus sensitivity. Rather, it occurs when subjective experience is at odds with objective measures of signal detection. Such a perspective makes it possible to interpret and understand many previous studies. In the past, it was not distinguished very carefully between subjective and objective indicators of perception. Consequently somewhat mystical notions of supersensitive unconscious perceptual processes abounded. Today there is consensus that subliminal perception consists of dissociation between an objective measure of perception and concurrent subjective awareness (Fowler, 1986; Kihlstrom, 1987; Greenwald, 1992).

Affective and cognitive processes can occur in less than 10 ms, and people are often unaware of the presence of such subliminal processes (Tesser & Martin, 1996). Zajonc (1980) stated that affective responses are believed to be inescapable, irrevocable, implicate the self, difficult to verbalize, and often separable from content. Many terms exist to classify emotion (see Salem & Rauterberg, 2006). Norman (2004) uses the terms:

• *Visceral*: primary, automatic, unconscious responses.

• *Behavioral*: also unconscious responses, but are slightly less automatic.

• *Reflective*: responses involving conscious thought and reflection.

Generally, reflective responses are most influenced by social and cultural attributes, whereas visceral responses have less variability from person to person. Visceral responses will vary the least between different user groups; whereas, reflective responses will vary the most. Spence (2003) suggests that the sense of touch is well suited to perception of differences in emotion. Thus, although performance measures are often dominated by visual and audio feedback, haptic feedback can potentially play a significant role in influencing affective responses.

For over one century, psychologists have consistently reported almost all affect variability to be described by three dimensions (Wundt, 1907; Osgood et al, 1957). Other researchers have since validated and refined these dimensions. For example, Lang's self-assessment mannequin (SAM) (Lang, 1995) uses the terms:

• *Valence* (e.g., pleasantness)

• *Arousal* (e.g., excitement)

• *Dominance* (e.g., control or prestige)

Self-report measures and biometric recordings are the primary methods of obtaining affective responses. Generally, self-report measures are preferred for analyzing smaller, relative differences between stimuli. Biometric measurements are better for absolute measurements. Differences between users desired and actual interpretations of instructions are one of the major sources of noise in self-reported measures. Although biometric meas-

ures are less affected by such misinterpretations, they are more sensitive to the environment (e.g., they are difficult to use in uncontrolled environments such as field studies). Learnt and biological differences will also affect biometric measurement validity.

Likert-type rating scales are often used for the three dimensions. Users will typically be exposed to a stimulus for a couple of seconds, and then be asked to rate valence, arousal, and/or dominance on a scale (e.g., 1-10). Exposure times of 5-8 seconds have been estimated to give users enough time to experience the stimulus, without giving them time for much conscious reflections (i.e., a 'gut' reaction is desired; Lang, 1995). Generally, it is assumed that approximately half of user's affective judgment variability is along the valence dimension, slightly less than half of the variability is along the arousal dimension, and most of the small remainder is along the dominance dimension.

Because valence and arousal are assumed to account for almost all affective variability, Russell et al. (1989) proposed and used these as the basis for a two-dimensional affect grid, and also related more subtle, specific affective attributes (e.g., happy, sad, joy, excited, frustrated) to various regions of the affect grid. Studies measuring more subtle affective states than the main dimensions of valence, arousal, and dominance have had some, but more limited success. Attempts have been made to map subtle affective attributes to a defined sub region of a 2D valence and arousal grid (Killgore, 1998).

User's affective responses correlate with a variety of biological responses including changes in muscle tension, skin conduction, heart rate, blood pressure, and breathing rate. Analyses of facial responses have been used already by researchers for a long time (e.g.,

Duchenne de Boulogne, 1862). Ekman and Friesen (1978) developed the Facial Action Coding System (FACS) where six affective attributes – joy, sadness, disgust, anger, surprise, and fear – can be manually coded from images or video. However, direct measurement with sensors is more accurate and nowadays technically feasible.

Functional magnetic resonance imaging (fMRI) and use of electroencephalogram (EEG) sensors have been used to monitor brain activity variations for different affective responses (Kemp et al, 2002; Allen et al, 2004). New research areas are prefrontal asymmetry and evoked response potentials. Although they accurately record affective responses, fMRI measuring devices are expensive and their magnetic fields can interfere with many interface technologies. Electromyographic (EMG) measurement of facial muscles is often more practical than full-head EEG or fMRI (because of cost, ethics, and complexity).

The state of the art in the empirical assessment of *Presence* experiences is best described by diversity. A broad variety of measures and methods have been introduced (Baren & IJsselstein, 2004), but only very few have been evaluated against the standard criteria: objectivity, reliability, and validity. The large variety of different measures is a consequence of the numerous theoretical approaches to Presence (Vorderer et al, 2003).

In the context of the European project 'Presence: Measurement, Effects, Conditions' (MEC) a variety of promising approaches to measure Presence has been selected and compared with respect to the standard criteria: objectivity, reliability, and validity. The 'MEC Spatial Presence Questionnaire' (Vorderer et al., 2004) meets the standard requirements and is based on an integrative theoretical framework. Most important

are still think-aloud techniques (Vorderer et al, 2003) for their ability to assess multiple dimensions of Presence during exposure, and task-oriented measures. For example, MEC has identified some capacity of the Secondary Task Reaction Time (STRT) paradigm to measure Presence 'online', although findings demand further exploration (Klimmt et al., 2005). A variety of alternative task-based measures has been proposed (Basdogan et al, 2000). The context of new experiences in entertainment suggests to employ a combination of process-oriented and ex-post measures of Presence and to establish improved, validated task-based methods.

The near-infrared spectroscopic (NIRS) imaging technique allows visualization of cortical activities during dynamic movements (Jöbsis, 1977; Maki et al, 1995; Eda et al, 1999; Hoshi et al, 2000; Miyai et al, 2001). The findings of Miyai et al. (2001) provide new insights into cortical control of human locomotion. NIRS topography is also very useful for evaluating cerebral activation patterns during gait and other movements using interactive technology. With the NIRS methodology a new approach is given to investigate the relation between physical presence, active immersion and enjoyment. As far as I can see NIRS is the only available measurement technology which allows in a limited way the user to move and behave throughout the measuring time of cortical activation. This seems to be a clear advantage of NIRS to get a deeper understanding of presence than already established approaches (IJsselsteijn et al, 2000). At least one publication describes the investigation of musical perception measured with NIRS (Katayose & Okudaira, 2004). Applying NIRS to investigate immersion and

presence is probably unique (Workman, 1999).

4.0   Conclusion

Based on the continuous increase in targeted size of user groups, interactive systems for a new kind of user experiences are coming up. We have addressed one important design challenge: how to design an interactive system based on the concept of Kansei Mediation. Although already several solutions are possible, we introduced and discussed a new approach via Cultural Computing (Rauterberg 2006a; 2006b). We proposed to do so by implementing Cultural Computing concept and enriching it with Kansei Mediated Interaction (Nakatsu et al, 2006). We relate our work to the Eastern and to the Western world, i.e. we focus on cultural examples from Japan and England. We proposed as a new direction for HCI, cultural computing with its related paradigm called Kansei Mediated Interaction (Salem et al, 2006).

Based on a short overview over the different paradigms for human computer interaction we introduce and discuss the most recent paradigm of cultural computing. Cultural computing addresses underlying and almost unconscious cultural determinants that have since ancient times a strong influence on our ontology and epistemology (e.g., Nisbett et al, 2001). Different cultural regions worldwide will have different approaches to address their particular cultural determinants. In the East, the project ZENetic Computer (Tosa et al, 2005) is a first and very promising approach for cultural computing addressing Eastern cultural determinants. In the West, we started the project 'ALICE' for an interactive experience based on the narrative 'Alice's Adventures in Wonderland' (Carroll, 1865) to address the main characteristic of the Western culture: (1) time,

(2) space, (3) self/ego, and (4) analytical reasoning based on formal logic

The upcoming paradigm of cultural computing introduces new research challenges (see also Hassenzahl & Tractinsky, 2006), such as: (1) what are the relevant cultural determinants in different cultures to enable the user to transform his/her self towards enlightenment (see Salem & Rauterberg, 2005b); (2) what kind of interactive experiences will have the most supportive potential regarding this transformation (see Nakatsu et al., 2005; 2006), (3) what are the differences between cultures worldwide and how to address them, and (4) how to measure the effects regarding the progress achieved in transforming once self. We have discussed several possible answers to these challenges (see in particular Rauterberg 2006a; 2006b) and can conclude that (ad 1) the Western culture is mainly characterized by analytical reasoning based on formal logic (Nisbett et al., 2001), (ad 2) the narrative Alice in Wonderland (Carroll, 1865) is a promising candidate for such kind of interactive experiences to address cultural determinants (Lough, 1983), (ad 3) cultural computing projects (e.g. ZENetic Computer) will not fit to Western cultures, and (ad 4) cultural awareness might be assessed by an appropriate combination of above described approaches to measure the effects of [un]conscious cognitive functions determining the user's experience, or maybe even by utilizing on the concept of the mandala as introduced by Jung (1959).

Acknowledgements

5.0   References

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