Haptic Interface Aesthetics – 'Feedback Loops, Live Coding and How to Harness the Potential of Embodied Estrangement in Artistic Practices and Aesthetic Theories within Interface Culture'

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Abstract. This article describes interface aesthetics from a trans-disciplinary perspective and reports on the findings of research into haptic interfaces through discussion of a series of prototypes and their potential as 'critical' design as opposed to 'affirmative design'. The article begins with analysis of the body - machine relationship positing human technogenesis as the framework for further discussion into humanistic computing; the use of feedback loops and live coding as artistic medium; and discusses outcome potentials such as reverse predictive practices and the notion of estrangement to stimulate thought and debate.

Keywords: Haptic Interface, Feedback Loops, Live Coding, Estrangement, Wearables Lab, Interface Aesthetics, Interface Culture, Wearables, Reverse Predictive Practices, Embodied Estrangement, User Interface, Human Computer Interaction, Human Technogenesis, Trans-disciplinary Research, Critical Design, Bamboo Whisper, Blinklifier, Snoothoods, Pulse Swarm.

1 Introduction

The Webster's Ninth Collegiate Dictionary defines an interface as 'a surface forming a common boundary of two bodies, spaces, phases.'

Scanning the plethora of citations across a range of dictionaries the term is used in many contexts including chemical, biological and sociological.

This article, 'Haptic Interface aesthetics: feedback loops, live coding and how to harness the potential of embodied estrangement in artistic practices and aesthetic theories within interface culture' is informed by research as principle investigator of the Haptic InterFace (HIF) project and current work as Assistant Professor and director of The Wearables Lab, a new trans-disciplinary lab for innovation, at the Academy of Visual Arts at Hong Kong Baptist University in the Special Administrative Region of the Peoples Republic of China.

2   The Expanded Field of Interface Aesthetics

Human-computer interaction studies have largely focused on the screen interface and concern themselves with how humans interface with information and computer technology (ICT) systems, focusing on issues such as how we approach bandwidth, processor speed and storage capacity, and gauging their success on user satisfaction statistics.

A contemporary approach to human-computer interaction could be viewed as an inversion of this; as design ICT systems are increasingly considering how computers approach humans. With the radical miniaturization of electronics, sensors and actuators combined with bio- and nano-technologies and global digital networks, information is now more than ever before directly embedded into everything imaginable. The bonds between human and computer are merging in ways that were previously only the dreams of science fiction. It is within this 'human-computer-confluence' that this paper considers an expanded field of interface aesthetics, one in which haptic interfaces have become the most interesting resource for the scope of design explorations.

Using the term 'haptic interface' is problematic and so as not to mislead the reader, it would be helpful to define my use of it here.

Since the beginning of 'interface aesthetics' in experimental digital art in the 1960's, the term haptic was adopted by game design engineers to refer to a very specific set of parameters such as rumble packs, mouse, keyboard, i.e. tools to communicate with the screen based information of the game.

Media studies have historically promulgated 'interface' synonymously to refer to 'human-to-software interfaces'. Brenda Laurel's 'The Art of Human-Computer Interface Design' (1990) [9] and Lev Manovich's 'The Interface as a new Aesthetic Category' (2000) [11] both contain many examples of this phenomenon. Manovich's work is to be applauded for its analysis of context ie: the relationship between subject, object and medium, but as Florian Cramer points out, his use of the term 'interface' could be replaced with 'media', and 'aesthetics' for 'phenomenology', or in other words the interface as machine and aesthetics as human. Reinforcing this Cartesian dichotomy is the common categorization of a programming interface (API) as opposed to a user interface (UI). [5] This inherent duality is unproductive to the scope of this article, which rather considers a future condition in which end users are extended programmers and programmers are users.

If we step outside disciplines we can further broaden our understanding. For example within Humanities 'interface' is a term used generally to refer to a common boundary. Whether that boundary is physical, visible, tactile or tangible, the profusion of interfaces in daily life means there is clearly a social dimension active within human-computer interfaces that effects cultural practices in ways that go well beyond the traditional user seated before a computer screen.

The 'human-computer-confluence' can be reimagined through the relative fluidity of notions such as 'live coding' and 'feedback loops', in which the programming interface is itself a user interface, and in terms of their potentiality in which case the artists work involves sculpting the interface/interaction – playing in the fluid

transmogrification of space between programmer and user, designer and consumer. '…interface does not stop at the computer's surface but goes beyond the buttons and reaches 'back' into history, and 'through' to the human senses and perception, 'behind' the concept of the interface, 'down' into the machine, 'out' into society and culture.'[1]

It is the aesthetics of this boundary that I consider the *haptic interface*.

3   Trans-Disciplinary Research Methodology

Across all disciplines the potential of interface aesthetics is increasingly expanding through collaboration and exploration at the conjuncture of aesthetic theories and working methodologies. This combined with the mash-up of new and old technologies from both analogue and digital realms and experiments in haptic and tactile interfaces creates new and unexpected experiences. [1].

The artistic methods proposed in this research stem from trans-disciplinary praxis, and consider the aesthetic and emotional experience of the wearer as primary to pragmatic and functional enhancements.

The research took place in the Wearables lab and references a broad range of methodologies that are intrinsically intertwined in the creation of prototypes (e.g. Design practice, computer science, systems theories, media arts, performance, sculpture, engineering and the humanities). The methods generically embrace 'process as research' and support collaborative practice in the generation of ideas in an interdisciplinary knowledge domain.

The HIF project brought a group of twenty professionals and creative thinkers from many backgrounds and cultures together for an intensive ten-day workshop to explore haptic interfaces. The resulting prototypes were presented as a pop up exhibition within the larger context of a curated exhibition of selected wearable works titled 'Haptic InterFace' at the Koo Ming Kown Exhibition Gallery, Kowloon Tong, Hong Kong.

Following are descriptions of some of the prototypes developed, collaborators names are in brackets, for more information about HIF visit http://hapticinterface.hkbu.edu.hk.

4   Prototypes and Directions for Future Work

Imagine wearing shoes that enable you to physically sense an awareness of another person walking. Sensors on the bottom of your shoes communicate via microcontrollers through smartphones to actuators located on top of another wearer's shoes. When that person sits to rest, you will feel the weight lift. When they run, you feel increased pressure and faster rhythm of the activity and visa versa, they can feel you too. People wearing the prototype shoes, and strangely sensing each other's activity, are currently walking around Trier in Germany, and Brisbane in Australia.

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[1] (Andersen & Pold, 2010) p.9.

An odd sense of awareness of the body rhythms of another person emerges in the mind of the partners. In this application the locations highlight the global diurnal disjuncture, for example dancing at a nightclub overlaps an early morning walk. (J. Donavan, D. Gilgen,)

Imagine a second skin interface that tangibly communicates through touch. When a New Zealand weaver, Hong Kong fashion designer and Portuguese media engineer put their heads together the result was a touch-sensitive kinetic dress that reacts, releasing a swarm of 'butterflies' to flutter around the wearer's neck. 'Nitinol' shape memory wire opens the collar and enables featherweight PVC butterflies to emerge, when the memory wire cools it relaxes, causing the collar to close again enveloping the butterflies. Life and theatre are poetically intertwined in this expressive garment. (M. Chueng, S. Coelho, K. Henson).

By wearing specially designed white leather gauntlets, with ostrich feather plumage highlighted by a diffused pulsating red light, two people can sense each other's presence even when they are out of visible range. The prototype gauntlets read the pulse of one person and send it as vibration to the other as haptic feedback. The proximity of the communication is, near field in contrast to the smart shoes mentioned above.

In informal trials, a couple wearing the gauntlets in a domestic environment reported that there was an enhanced sense of connection between them supported by a subtle awareness that the other was within proximity, before they approached the boundaries of being seen they were felt.

This experience sounds like a physical manifestation of the film editor's trick of overlaying 'fade in/out' to join spliced footage without the viewer experiencing any visual jolt. This is often done aurally by overlaying the audio from an image so that it can be heard just before the corresponding vision, cushioning the transition. In this prototype the experience is through haptic means. It would be difficult to surprise somebody if you could sense their pulse just before they appeared.

Further investigation could test the effect on the body's biorhythms with prolonged use in cohabitation. Perhaps with greater implications, the production of many cuffs and their trial with larger groups will enable exploration of 'swarm behavior.' [5] (G. Sade, P. Bracks, D. Brough) For more information on this project visit http://kuuki.com.au/.

5   Analysis

The Haptic Interface workshop provided a space, both physically and mentally for participants to step outside their daily professions and spend focused time reflecting on one theme and exploring it through hands on experimentation and praxis. Creativity was enhanced by participant initiated 'circle workshops' in quick response to a problem when it arose. This structure was embedded into the program and designed to maximize skill and knowledge sharing. Another contributing factor was the careful selection of a dynamic mix of participants with differing skills sets, cultures and experience and an induction into the trans-disciplinary and multi-cultural

work environment. In this, everyone works with different languages, methodologies and has different ideas and expectations about outcomes. As the introduction alluded, even the terminology provides fodder for contentious debate. An open-minded attitude enables progress, and in fact, it is at the point where differing perspectives collide that sparks of creative ideas emerge. The misunderstanding and misinterpretations provide richness to the workshop forum that is both challenging and fruitful.

Projects such as these are reimagining our perception of time and space and our presence within it. Chris Salter suggests 'human and technical beings and processes are so intimately bound up in a conglomeration of relations that it makes it difficult, if not impossible to tease out separate essences for each.'[2]

Bernard Stiegler [14], Mark Hansen [7] and N. Katherine Hayles [8] would agree, they claim the relationship of human and machine to be fundamental to our natural evolution as a species, and propose human 'technogenesis'[3] as a framework with which to deconstruct and rethink the body-technology binary.

The tools we work with mediate our relationship with the physical materials that the real world is made of. When you work with your hands on a medium you gain an inherent understanding of the properties of that material that are difficult to explain or learn by means other than doing it.

Hand tools act as extensions of the body, their use often involves gestures that the body learns to work with, without conscious thought an idea can flow from the mind through the hands into a work of sculpture for example.

Mechanical tools usually declare their function by their physical structure. There is a mechanical logic at work when you see the operation of a typewriter or a bicycle that you can imagine by looking at the design.

With digital tools this mechanical logic has become invisible. There is no correlation between the material presence of the machine and its potential, which now depends on a network of divergent activities, differing relations between the machine and software packages, 'an ontology of techniques – that assumes the original relatedness between the material and the immaterial as its condition of possibility.'[4]

The fungibility of code enables fluid transformation between media. The representation of information in slightly altered states, or new forms, underlie the artistic tactics employed in the projects described in the case studies.

6   Case Studies

The author collaborated on four projects, which shall be briefly introduced and then the focus will turn to one project for a more in detailed case study. 'Blinklifier' is a wearable computer that amplifies eyelid movements into a visible light array. It uses bio-data directly to interact with the computer, although it can be consciously

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[2] (Salter, 2010) p.xxxiv.
[3] The belief that humans and technics are coevolving.
[4] (Benjamin, 2005)p.229.

controlled, it is designed to avoid conscious interaction and instead directly amplify the body's expression. Facial expressions are complex but easily recognized and naturally understood. By their amplification through bodily worn devices, something usually overlooked in everyday life can become a rich source of knowledge, or open potential for new ways of communicating our emotions and of understanding others. [6] Details of this project are published in the article.

Extending this research we designed the 'Snoothoods', which are wearable pillows that surround the head and alert the wearer if he/she begins to snore. Based on a skivvy design around the neck that holds sensors in place, an Arduino single-board microcontroller and vibrator are embedded inside a padded sculpted hood.

Two versions were designed, a Western and an Asian; the first is shaped like an egg laid on its side. This fully felted headpiece has the appearance of a surrealist sculpture, made from white felt, metaphorically evoking a cloud as an apt reference for dreaming and sleep. The second draws on the form of a traditional Chinese pillow, cushioning the back of the neck. This bow shaped form is permanently affixed to the neck and hood. (Flanagan, P. Vega, K., Fuks, H.) The aims and objectives of this project are expounded in the article 'Future Fashion – at the interface' also found in this volume so it will not be further discussed here.

'Peripatetic people' is an installation that explores virtual reality through the construction of a series of analogue machines that present 3D visual representations of people. Simple electronic input devices such as motion sensors and output speakers with mp3 players create an immersive environment for audiences to interact with virtual people in a room that on first glance is filled with mechanical apparatus and lights. Upon closer inspection it is possible to look in macro detail at a persons body, the wrinkles of their skin, the weathered leather of their shoes, the rings on their fingers, the proximity to which breaks with conventional rules of privacy. The visitor becomes voyeur, but at the same time it is their presence that sets the work in motion, as the virtual people discuss their ideas of boundaries and borders the visitor is forced to consider their own.

Common to both of these projects is what Steven Mann terms 'humanistic computing'. The concept of direct communication between human and computer without involving conscious thought, exploring the notion of connection directly between bio data and techno data. [10] To further explore humanistic computing, bio data and experiment with feedback loops we created 'bamboo whisper'. A set of wicker wearable microcontrollers that communicate through the reconfiguration of data: from spoken words into visual movement and percussive sound. The hats are reminiscent of elongated Victorian bonnets: they measure the volume from the voice of one wearer and amplify it into kinetic energy in the other's bonnet. One person experiences the voice of the other visually, through the movement of the brim above her eyes, and aurally through the chattering noise that the movement creates in the bamboo reeds from which the hat is constructed.

The hat vibrates causing the brim sticks to chatter; in this way the voice is translated into a kind of whisper. Each hat responds to the other, engaging the wearers in an immersive, interactive, haptic, audio-visual experience. Both devices

incorporate an electronic system powered by an Arduino Lilypad. Via integrated microphones and XBee radio the voice of one wearer is transmitted into movement and sound of the brim sticks and vibration felt on the other wearers neck.

In this work as in 'blinklifier' above the computer components and circuits are not hidden but barely visible. The circuitry has been inlaid into the structure of the felt at manufacture and onto the surface of the bamboo. The result is a product that seamlessly integrates traditional craftsmanship with what could be described as embodied magical capabilities.
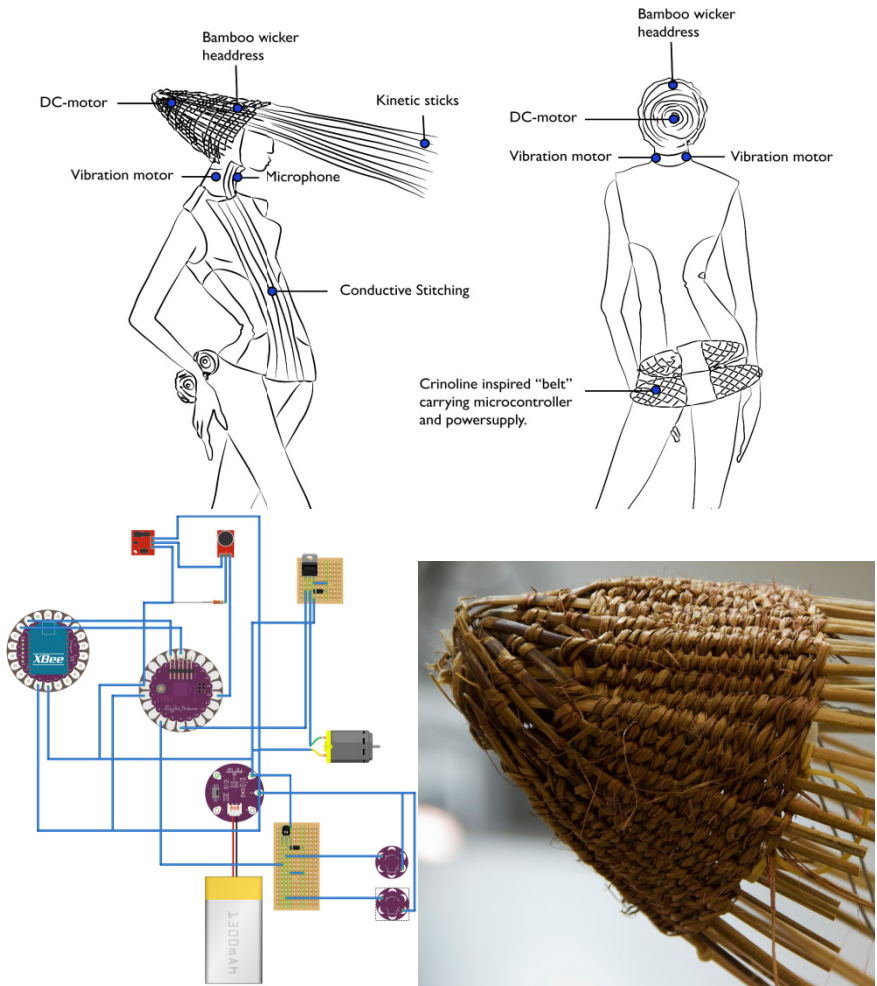
Fig. 1. Bamboo Whisper components and their locations, plus detail of weaving structure. (Illustration: Flanagan, Frankjaer).

7   Reverse Predictive Practices

In response to increased computing power and speed, artists are drawing on live data as a medium in their work to create responsive, ever-changing, experience environments. As we store ever-increasing amounts of digital data and our retrieval systems are capable of finding thousands of examples in response to any keyword there is a need to seek the most efficient method of communicating the presence and meaning of a wide range of analytic patterns.

Speaking at the NODEM conference in Hong Kong Prof. Lewis Lancaster gave a lecture called 'Europeana and the Future of the Archive' in which he boldly declared that he had to give up writing in order to see it. His research into reverse predictive practices and imaging data is inspirational. A very effective way to analyze large amounts of data is through its visualization. His experiments with reverse predictive practices grew out of a mass of data that was correlated through scanning of textual corpora such as canonical texts, archival documents and digital records of artifacts.

By changing natural language into abstract images, for example text characters into blue dots, the data can display word occurrence and patterning by tonal and density changes. In this way anomalous patterning found in past data sources can express new meanings and unprecedented readings. In Lancaster's work one such anomaly in patterning revealed that men travelled more widely that women during the period in Asian history that the text was written. The focus becomes one of asking the right questions in response to data evidence that is visually apparent. Rather than a codex system as in previously established methods of dissemination, the revelations that become apparent are specifically tied to the digital.

In Bamboo Whisper verbal language becomes a rhythmic and visual pattern. It will be interesting to examine how this new media can be interpreted and provide insight in a reverse predictive sense into the original language, speaker, content and context. I am encouraged by a previous project in which I recorded audio from speakers discussing their relationship to the ocean or rivers. Interviews took around the world place in Italian, German and English, which became part of an interactive installation called Preserved Fish that has visited audiences in Europe and Australia and will travel to Hong Kong Maritime Museum in 2014. To maintain a sense of cultural integrity in the work it was decided to play the soundscapes using the original voice. A short excerpt is translated and available, but the experience overwhelmingly is a musical one. A sense of richness emerges in the appreciation of individual culture through the rhythms and the intonation of its language in a way that would be impossible if one was to focus on the translation of individual words.

Reverse predictive practice is just one example of the potential of the expanded field of interface aesthetics through the fungibility of digital data.

8   Conclusion and Future Work

The objectives of our design products are open to conjecture. Rather than the traditional aim of design to solve set problems, affirm consumer behavior, and prove validity of product for market, our aim is to produce 'critical' design that poses carefully crafted questions that break away from the media representation of reality

and challenge the way we experience the world by estranging perception and presenting reality askew. Critical design will never be popular in mainstream culture and therefore will often remain as bespoke individual works that challenge audiences to think. Affirmative design on the other hand is fundamentally unsustainable.

The participant's prototypes from the Haptic InterFace workshop will be further developed and the final results exhibited 12 months after the initial workshop. At that time further analysis of the results will be conducted.

All interfaces involve the translation of signs and signals and as such, interfaces are as key to the inner-workings of the computer as they are to our sense perception of the techno-savvy contemporary world.

In the knowledge that the way we perceive our contemporary environment is through these interfaces, our objectives are that of stimulating discussion, posing questions and generating dialogue. 'The designer becomes the coauthor of the experience[5] and the artists role is no longer that of the object maker but has become one of social agent. The focus on 'sign and object' has evolved to 'signal and software'. The objectives are in terms of 'social sculpture' [3] and the interface is in terms of 'relational aesthetics' [4].

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