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Title: The Proximity Interface and Human Computer Interaction

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ABSTRACT
The tools with which the media artist works and the infrastructure within which the artwork is made and exhibited are critical determinants of how work is received and considered. This paper will build upon earlier investigations by myself and others into interactive art installation as models for informing development of HCI. These areas of practice-based research and the resources available online for the development of solutions based on modular electronics, suggest there exists common ground for scientist and artist to explore for revising the interface as an experience built from components - of presence, of devices and of code.

INTRODUCTION

The 'I' in HCI stands for Interaction, not as I used to believe, Interface. The distinction is I believe critical. Go to the ACMCHI website and the one-line definition of HCI hasn't changed since 1992:

> Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. (ACM 1992)

The word 'interface' and its relation to HCI is mentioned two paragraphs later, but not as a definition:

> Take the notion of machine. Instead of workstations, computers may be in the form of embedded computational machines, such as parts of spacecraft cockpits or microwave ovens. Because the techniques for designing these interfaces bear so much relationship to the techniques for designing workstations interfaces, they can be profitably treated together. (ACM 1992)

Whilst skating over what might be meant by the term profitable – advancing knowledge I'm sure - I think my confusion is directly attributable to narrow definitions that reduce interfaces to being 'designs' or 'layouts' for controlling a machine rather than as artists have defined, states of interaction involving not only feedback loops or communication cycles but an active presence which affects the whole. Darren Tofts described this in 21C in 1995, (1) (Tofts 1995), I repeated in the catalogue for Burning the Interface in 1996 (Leggett 1996) and we are still saying it - an interface is not a function, it is a dynamic entity, a state of flux, the location of performances and interventions. It is not something tied by a mouse to a tasteful screen layout, with buttons to press and tasks to achieve. The interface needs to become a three-dimensional spatial experience able to create possibilities for the interacting subject not even envisaged by the designer and the programmer.

In this paper I want to briefly discuss some of these issues, then look at the kinds of 3D HCI research models being developed by artists, designers and computer scientists, before outlining the kinds of devices being used to build these models, the resources available to do so, and how these address or not, researchers' needs and objectives.

INTERACTION RESEARCH

The distinction between ‘interaction’ and ‘interface’ is important as it clearly affects not only the approach taken by researchers to human computer interactions but also reveals an attitude to that difference in terms of resultant outcomes. These distinctions may be characterized by summarizing some goals:

> the HCI researcher seeks ‘to develop and improve the safety, utility, effectiveness, efficiency and usability of systems that include computers. (Interacting with Computers 1989, 3), or be ‘concerned with understanding, designing, evaluating and implementing interactive computing systems for human use.’ (Preece 1994, 26)
>
> the artist seeks to develop a culture in which its creators became part of a complex and widely distributed system. It involves both human and artificial cognition and perception and is ‘an art that is emergent from a multiplicity of interactions in data space’ (Ascott 1993, 261).

The contemporary artist sets out to create a system for the human with conditions that stimulate thought, delight the senses and move the spirit through active engagement with the structural components of the encounter, both its form, content and conveyance. This has been described in various ways from Herbert Read (2) (1964) to Michael Joyce (1996). Intentions rather than goals help to guide rather than direct the process of encountering computer-mediated artworks.

Whilst exploring these distinctions, various useful ‘crossover terms’ have been found that have currency within either research area - like ‘affordance’ and ‘ecological’ and ‘presence’ – though context is of course essential for semantics. The term ‘presence’ loops back to another word in the title of this paper which likewise raises problems with semantics – ‘proximity’. By implication we ask, proximate to what?

PRESENCE

Interaction between an artwork and the physical presence of the visitor is not an original technical innovation in the context of contemporary media art, but the way in which this element is introduced needs to have tacit consideration. Presence implies at least two bodies in proximity to one another, (only one of which needs to be sensate), the presence of the other being detectable by operation of the sensing tools. Cognition will (eventually) determine an outcome – realising absence if the other has since departed initial detection, otherwise confirming a palpable presence.

The term 'immersion' in this context is problematic, suggesting a disregard for the agency of the subject, somehow removing volition and substituting something manipulated 'remotely' by the installation artist or the HCI designer, creating a functional interface that sets out to achieve a particular goal as suggested by the phrase, ‘he was immersed in the gameplay’ or ‘she was immersed in her work….’.

The presence of a viewer is assumed by the artist – this makes the act of viewing the surface a dynamic experience. Whilst some visual artists (like Bridget Riley 1965) explored retinal response to optical patterning produced at different viewing distances, two and three-dimensional artwork which actively responds to the viewer’s changing physical position is a relatively recent phenomena emergent from electronic media. How does this affect our understanding, our feeling of presence, of proximity to and participation with(in) the artwork?

Roya Jakoby, a visual artist, in discussing with others the word ‘aura’ describes it thus:

> maybe it's better to call aura the atmosphere or presence of something ….. You know it

> when you see it/experience it. Sure, there is also the physicality aspect (electro-magnetism) of all things, but that alone doesn't create a strong presence. It is an emotional, somewhat transcendent quality inherent in a being, an object, a piece of art (no matter what medium). Some people call it also the energy of something or *charisma*. Digital artefacts have of course presence. Some have more of it, some have less. There are various parameters that determine such a presence, or the lack of it. (Jacoby 2003)

Though this discussion doesn't go on to explore these parameters, another group of researchers have actively pursued this in a telematic context. Known to us as telepresence but known to 'presence researchers', with their own conference and journal and several websites as, 'presence', their current definition is:

> a psychological state or subjective perception in which even though part or all of an individual's current experience is generated by and/or filtered through human-made technology, part or all of the individual's perception fails to accurately acknowledge the role of the technology in the experience. (ISPR 2004)

Fortunately the debates amongst this group are very much more stimulating than this bland description. Mantovani & Riva for instance, develop an argument from their perspective, much discussed by artists and theorists over the last decade, that presence is a social construction "mediated by both physical and conceptual tools which belong to a given culture" in which there is "the emphasis of ecological approach on the primacy of action on mere perception", and that "action is not undertaken by isolated individuals but by members of a community. …. Ultimately, there are only two elements which guarantee presence: a cultural framework and the possibility of negotiation of both actions and their meaning". (Mantovani & Riva 1999)

The language used and the conclusions reached in this brief example from telepresence researchers, by coinciding with debates amongst media arts researchers can be considered positive indications of grounds for collaborative work to occur.

INTERFACE MODELS

Whilst issues related to presence and interface continue to be explored, interaction within the multi-disciplinary domain of HCI and media arts is less at issue. Other studies have documented artists working in these domains. Thirty years ago Cornock and Edmonds (1973) described interactive 'art systems' as being: 'static, dynamic-passive, dynamic-interactive, dynamic-interactive (varying)'. These categories were further developed more recently by Candy and Edmonds (2002) with examples of work produced by Sid Fels, Jack Ox, Esther Rolinson, Mike Quantrill, Anthony Padgett and Ernest Edmonds.

Descriptions of interacting with computer-mediated artworks have been numerous. In encyclopedic form there is 'Information Arts' published in the USA and based on work exhibited at the annual ACM SIGGRAPH event (Wilson 2000) and 'New Screen Media' published in Europe (Reiser 2002). Specific articles and papers in Australia have included: using mouse control over CD-ROMs made by artists (Leggett 1996) (Tofts 1996); 'mousing' through online interactive movies (VOGS) (Miles 2000-04); artists' websites and the dynamics of net culture (3) (Rackham 2004); three-dimensional interactive installations (Leggett 2004).

The informal research projects of interactive media installation artists conducted over the last 10 – 20 years can be characterized as modular in their approach to addressing issues that scientists would approach with a more formal methodology, leading to outcomes articulating the means (theoretical and practical) of problem-solving. For instance, in 'A Gesture Processing Framework for Multimodal Interaction in Virtual Reality' (Latoschik 2001), the author describes a 3D HCI model by means of which 'establishing general input data for gesture recognition' is achieved, then processed through sequential stages of computation, prior to linking with data generated by

speech. Here the emphasis is on testing a model that whilst extending the users agency into a distributed VR network, bases the metaphor on the mimicking of the physical activities required to complete a task in actual space.

The model the artist develops in 3D HCI focuses on the process of negotiation between a human, in an actual space, together with a microprocessor-mediated feedback loop modifying perceptions of the subject's presence within the system made up of those three entities. The feedback may happen based only on data captured real-time in the installation space, or the same data combined with data from the computer's memory, the network to which it is connected or the peripheral machines it controls. This I have analysed in the installations 'Between That Seen', James Turrell, (1986 - which is not computer-mediated), 'Swarm' by Alex Davies (2003) and 'Changing Light' by Chris Welsby. (Leggett 2004).

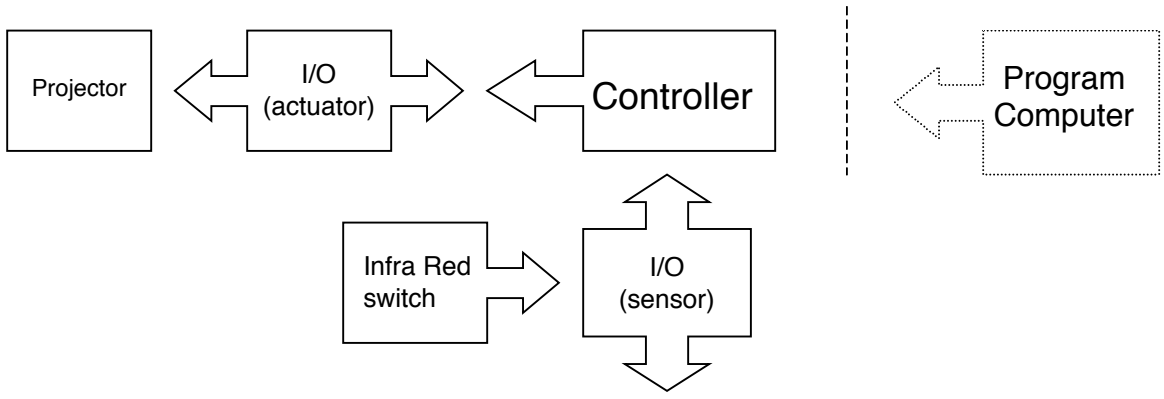
If the scientist seeks to solve problems associated with achieving effectiveness and efficiency of task completion within a system, the artist seeks to invite participation which is different for each visitor, returning experience which is structural, thus non-linear, and appealing to an emotional investment, if only that of the inquisitive and the exploratory.

INTERFACE DEVICES

It is from models developed through practice-based research that we can begin to approach more theoretically the broader possibilities of the interface. But developing interface models of the kind described above is obviously dependent on the current state of the art in hardware and software technology. Development of the technology is driven by ideas generated by designer and engineer, often consulting with scientists in AI or VE, working together to invent (and patent) 'devices' that will deliver a different audio-visual experience. Devices are hardware, either controllers which require on-board or network software in order to function, or connector interfaces such as actuators or sensors to issue or receive data to and from other machines in the system.

The distinction needs to be made between on-board or network software running the installation. In the case of a network, instructions to and fro (Input/Output) will flow via an operating system running on a computer dedicated to the task. This not only ties-up an expensive tool but is vulnerable to operating system crashes and the restart procedure hated by every exhibition manager in the world. 'Stand-alone' solutions of the kind that will be described, are hardware and software stripped back to the bare essentials in order to achieve the desired interface and interaction. A computer is used simply to 'set-up the functioning of the stand-alone components before the installation is left in effect, to look after itself and its human partners.

A functional block diagram shows the relationship between 'program computer', used to prime the microprocessor in the 'stand-alone' controller with the rules for the system contained in a short program, and the I/O (input/output) devices that in turn control or/and respond to, the other machines:



The commercial exhibition industry has developed many devices. This is an area dominated by a production model approach and the technology itself has been developed with a linear approach to problem solving. Whilst the experience created may offer some participation for visitors within the work, the engagement, like its genesis, is too often linear, employing familiar sounds and images that deliver what the industry calls 'content' or edutainment. Complexity of this kind of course requires considerable computing control.

Solutions range from the big budget Integrated Content Servers used either for "The 82nd Airborne's first-ever portable command center employing the power and speed of AMX control technology" or for new permanent museum sites like the National Museum of Australia in Canberra. Down the road at the War Memorial individual exhibits are upgraded at a component level using devices like a controller for a DVD player or digital video server, manufactured by a corporation and costing together $5000 and upwards.

The cost of development and short-run manufacture means such devices are marketed only to the exhibition industry, who work within the given set of aesthetic and operating principles realisable by the industry's designers.

Though some devices like the digital (solid-state) video server are immensely attractive, the artist or interface researcher, due to reasons of cost but primarily objectives, has to take other approaches.

INTERFACE DEVELOPMENT APPROACHES

The Canadian artist, David Rokeby describes the principle of exploration and risk-taking in his 'Very Nervous System' (Rokeby 1986-2000). It is a cogent description that could be almost generic.

> "The active ingredient of the work is its interface. The interface is unusual because it is invisible and very diffuse, occupying a large volume of space, whereas most interfaces are focused and definite. Though diffuse, the interface is vital and strongly textured through time and space. The interface becomes a zone of experience, of multi-dimensional encounter. The language of encounter is initially unclear, but evolves as one explores and experiences. Very Nervous System is the third generation of interactive sound installations which I have created. In these systems, I use video cameras, image processors, computers, synthesizers and a sound system to create a space in which the movements of one's body create sound and/or music."

Like the designers of commercial exhibition spaces, approaching the development of art systems can also be affected and predetermined according to the budget available and the knowledge level of the researcher. Locating sympathetic engineers who have worked with artists is one solution. The Sydney-based engineer and artist, Stephen Jones, worked in 2004 with the indigenous artist, Rea, to develop a stand-alone multiple DVD Player Controller designed around an embedded micro-controller. The device provides for a range of sensor inputs to trigger up to four DVD players, with an option to fade between video channels. Programming the micro-controller uses assembler level language delivered from an external computer.

Customised solutions to specific installation requirements may seem ambitious to an artist's project budget but if the relationship works, the benefits can be exponential in terms of success and the flow-on for both artist and engineer. Jones's service enterprise is part of an extensive network of entities including corporations, small businesses, educational and public enterprises, most of whom enable through their websites, access for different levels of user knowledge, to customized, ready-made, partially constructed devices, in kit or components form.

Public enterprise projects or the 'community of interest' development of tools and devices has of course blossomed under the sun of the internet, particularly by providing on-line manuals and

guides to the development of projects accessible to those without many engineering or computing skills. ‘The idea here is that a collaborative space is provided to allow the AID community to support itself’, is how the AID (Artists Interface Device) project at interAccess in Toronto, Canada puts it.

The project description specified that ‘The AID will be capable of input and output via USB, RS232 serial and midi protocols. An array of secondary cards will allow artists to control virtually anything that uses electricity, for example DVD and Laser Disk players, lighting, music keyboards, audio CD players, speakers, motors, fans, pumps and so on. These kinds of "actuator" device can also be made to control or effect things which are not electrical.’

After several years of development work and following the launch of AID in May 2004, a message on the site sadly announces: “Download all the Development Kit files as a zip file - No Longer Available. *NEEDS UPDATE*”. Is this another case of the funding or the volunteers running out of steam?

Another website grandly named the Institute of the Future acts as a portal for various development projects including an Art and Technology venture by Casey Smith named Junkfunnel Labs. As a recent Master graduate from the MIT Media Lab (Smith 2002) and as artist with a collection of work in art and technology, his interest is also ‘in helping the field of art and technology grow … and improving artist/engineer collaborations, providing technology resources for artists, or collecting links to the literature and work of the field.’

Another link from this site is to the Cricket. This is a tiny computer, powered by and about the size of a 9 volt battery. It can control two motors, receive information from two sensors and is equipped with an infrared communication system that being wireless, offers advantages over other stand-alone devices. Developed within the Media Lab at MIT, Crickets are the result of ‘cross-breeding’ with the Programmable Bricks project, a range of wearable devices.

The Cricket and its technology emerges from the educational sector and so is freely available to artists and designers to build from components. MIT have also licensed to Handy Board Inc the right to manufacture it under the name The Handy Board. Modifications include an LCD screen and an integrated rechargable battery pack. This design is also available from RobotOz, a Perth mail-order business for $AU400

So the network of possibilities emerges as something more complex than one option or another – from the voluntary to the educational to the small business component and kit provider, all are intertwined in a series of relationships that address both the consumer and the researcher.

The Perth small business also supply Basic Stamp, another controller device which is sourced from Parallax Inc, a large US electronics distribution corporation, who provide everything from kits and tutorials for people needing to know more about electronic engineering to advanced components and devices used in a range of applications in many different industries.

Another British company, Picaxe, also make re-programmable chips that can be used as what they call “low-cost brains” in many kinds of electronic project. The emphasis here is educational – logic and programming - with excellent manuals and cheap $AU40-50 per starter kit. Making Things also has an educational mission with excellent documentation material but, being in the USA, market their contribution more aggressively. They enable newcomers to build interactive displays, exhibits and installations and getting started with the Teleo Introductory Set will cost about $AU300.00

Moving into the more advanced areas of user knowledge is another US corporation Crossbow, whose wireless sensor platform, like the Cricket but on a more advanced scale, gives the flexibility to create powerful, wireless, and automated data collection and monitoring systems. This is an expensive system though the majority of the hardware is plug-and-play, and all of the

components are intended to operate using the TinyOS operating system originally designed by University of California Berkeley as an open-source operating system designed for wireless embedded sensor networks.

CONCLUSION

Interaction Research – Complexity: The issue that begins to emerge at this level of practice, is the trade-off between the complexity of the system, the ease with which it is constructed and its cost, and the efficiency and reliability with which it operates. In seeking to avoid the complexity of generalized operating systems like Windows or OS10, to instead provide a 'stripped-down' simplified computer with only the code it needs to operate as a stand-alone interactive installation, might then limit the extent of exploration that can be made into the development of either art installations or models for the 3D HCI.

Interface devices**:** Approaching complexity on a structural level, where the interface and thus the experience is built from components of devices and components of code, has already been foreshadowed by the researchers on the Cricket project, who observed of their device:

> "First, it will allow creative designers to prototype fully functioning digital behaviors, and thereby deeply influence the human qualities of final products. Second, it points to a future where end users will be able to redesign the functionality of the devices in their lives. We are looking forward to a day when the functionality of appliances and other manufactured articles is transparent, and consumers can reconfigure the technology around them in novel ways." (Martin et al 2000)

Presence: The language used and the conclusions reached in this brief example from telepresence researchers, by coinciding with debates amongst media arts researchers can be considered positive indications of grounds for collaborative work to occur.

Interface models: Descriptions of interacting with computer-mediated artworks have been numerous however, analysis and evaluation by computer scientists and analysis and critical response by artists and theorists need to be cross-referenced for complete and informed benefit.

Other Development approaches : The range of resources available to practice-based researchers, artists, curators and exhibition venues goes much further than this brief overview has described. Another kind of approach might be practice-based re-purposing of 'obsolete' technology such as has been continuing in the Linux community. The Xbox games consul is a legacy-free PC by Microsoft that consists of a 733 MHz CPU, a video card designed for high quality graphics, a 10 GB hard disk, a DVD drive and 10/100 Ethernet. It's a $AU1000 computer that costs $AU350, the same as one of those microprocessor boards. Loading the Xbox with Linux can turn it into a full desktop computer, or if you visit www.xbox-linux.org, the whole spectrum of possibilities offered by open source code projects.

As the cost of computing technology continues to drop, as the interface becomes spatially interactive using richer media functionality, as the microprocessor becomes more embedded in functional interfaces, we should regard the 'compact computer' as a fact and concentrate our research, both individually and collaboratively, on improving our understanding of programming options and sensor networks in responding to and affecting the delivery of the 3D HCI experience.

NOTES

1. “What, or more specifically when, is an interface? [The assumption is]..that it only exists in the cybernetic domain, when someone sits in front of a pc and clicks a mouse. An interface, on the contrary, is any act of conjunction which results in a new or unexpected event. A door-handle, as Brenda Laurel reminds us, is an interface. So too, (quoting Lautremont), is the ‘chance encounter, on an operating table, of a sewing machine and an umbrella.’ James Joyce didn't write books. Marcel Duchamp didn't create works of art. John Cage didn't compose music. They created interfaces, instances into which someone intervened to make choices and judgments that they were not willing to make. ... You are empowered, you are in control. Cough during a John Cage recital and you are part of the performance. That's an interface.” (Tofts 1995)

2. ..the basis of the work of art was no longer Nature, but Ideas – something conceptual, geometric, architectural. (Read 1964, 76)

3. Today, online, we are surrounded by many forms of Internet art. From streaming video, elegant interactive java works, electronic poetry, net.radio and tactical media, to the phenomenally successful genre of intimate video or panoramic blogs. We may interact within artist-created multi-user Virtual Reality and Game spaces, and watch new theatrical and cinematic forms like avatar performance and machinima. Flash animation has penetrated almost every corner of the Web; and the network itself becomes an artwork as software art and browser interventions reformat and recontextualise HTML code. Net.art creates a mixed reality when data captured from one space is transposed and revisualised in another location; or when the monitored interactions of both artists and users becomes the bio-input for an artwork. (Rackham 2004)

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