

Interactivity - who cares?
Simon Penny, 2010
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Abstract

This paper places contemporary modalities of digital interaction in an historical context of a quarter century of technological development and artistic experimentation. Specific works are discussed as exemplars of significant milestones in the engineering and the aesthetics of interaction. Motivations for the pursuit of interactivity are reviewed, This review permits a discussion of changing logics of interaction in the context of naturalisation to increasingly sophisticated digital tools and appliances and the current period of ubiquitous computing.

Introduction

As I write this, at the end of 2010, it is sobering to reflect on the fact that over a couple of decades of explosive development in new media art (or ‘digital multimedia’ as it used to be called) the aesthetics of interaction doesn’t seem to have advanced much. Having focused on the development of interactive art for over two decades, I confess that I now find the whole idea somewhat tedious. And at the same time, interaction schemes and dynamics which were once only known in obscure corners of the world of media art research/creation have found their way into commodities from 3D TV and game platforms (Wii, Kinect) to sophisticated phones (iPhone, Android). A review of some works which mark significant developments in the modalities of interaction in interactive art thus seems timely, if only to confirm or cure my jaundiced view. This inquiry leads directly to taking stock of the state of interaction in the current era of ubiquity, and finally to ask what the future might hold.

Interactivity and the emergence of Digital Cultural Practices

I identify the two-decade period - roughly speaking 1985-2005- as the heroic experimental period of interactive art. This period neatly brackets the emergence of most of the major technological milestones which now undergird digital culture and ubiquitous computing: the graphical interface, WYSIWYG, digital multimedia, hypermedia, virtual reality, the internet, the world wide web, digital video, real-time 3D graphics, mobile telephony, GPS, bluetooth and other mobile and wireless communication systems. It was a period of technological euphoria and hype.

In that period, all kinds of experimental interaction modalities were realized by artists – most deploying custom or cutting edge technologies. Some of these modalities have become absorbed into commodity interfaces, others have faded away like dinosaurs (CAVE). It is therefore the periods we should examine to discover the roots of ubiquitous technologies and the motivations for such.¹

While the notion of a performative and processual aesthetics of interaction has been bandied about for twenty years or so (not least by myself), looking at interactive art over that period reveals little in the way of development in the formal qualities of interaction per se. The interactional logic captured in Edward Ihnatowicz' *Senster* of the early 70's remains paradigmatic. (IMAGE?) In terms of autonomous behavioral repertoire, Grey Walter's *Tortoises* of the late 40's set a standard seldom exceeded since. It is with some chagrin that I accept that my own work *Petit Mal* cannot claim to have advanced such dynamics much. The complexity of the creative agency of Gordon Pask's *Musicolor* of the late 40's is seldom attained. The *tortoises* and *Musicolor* were entirely analog, and *Senster* had the digital processing power, roughly, of a Tamagochi. Around the time of the *Senster*, Myron Kreuger pioneered machine vision based embodied screenal interaction. There is little in the *Wii* which was not roughed-out in the several iterations of *Videoplace* forty years before.

¹ see my *Trying to be Calm*

Hubert Dreyfus asserted that the claimed advances in AI over the period of roughly 1965-1985 could be attributed entirely to advances on hardware engineering – faster processors and more RAM resulted in larger scale brute force search, etc .² This assertion seems to have some justification, given that while formal procedures and basic techniques did not advance significantly, the computer upon which Deep Blue's chess program ran in 1997 was ten million times faster than the Ferranti Mk1 upon which Christopher Strachey's chess program ran in 1951. Could it be that the design and aesthetics of interaction are subject to the same conditions of increase of technical capability without significant development of ideas? The rapid advance in bells and whistles permits interfacial cosmetic niceties undreamable 20 years ago.³ Techno-fetishism of higher resolutions and faster bit-rates primarily serves the needs of an industry which depends on obsolescence to remain profitable and can only temporarily obscure a void of significant advancement or even novelty. Like HD TV and 3D TV, the prospect of the same trivial and pathetic 'content' consuming more bandwidth quickly becomes tedious.

The very existence of commercial and commodity interactive digital multimedia may have actually impeded aesthetic progress in the field, because of a confusion between interactivity for instrumental purposes and interactivity for cultural purposes. The interactivity of conventional software tools, say a word processor, should ideally be utterly transparent, 'intuitive' and instrumental. In Heideggerian terms, it should be 'ready-to-hand – to the extent that it is noticeable, it is bad. This, one might argue, is exactly the opposite of what aesthetic interaction ought to be - it should not be predictably instrumental, but should generate behavior which exists in the liminal territory between perceived predictability and perceived randomness. A zone of surprise, of poetry.

Because art practice is predicted on public exhibition and an imperative of some degree of public accessibility, and because all interfaces were unfamiliar (not a condition

² see Dreyfus 1972, etc

³ Steve Wozniak recently commented when asked if he foresaw internet porn, he observed that the early Apples did not have enough memory to render a (color) image, to say nothing of real-time video streams. (Radio interview, US Public Radio, Dec2010)

experienced in the closed environments of university and corporate research labs), the task of providing ‘intuitive’ access to unfamiliar modalities was (an often uncommented and under-theorised) part of the design task of artists. When interactive digital artwork began, the work focused on celebrating the novelty of, ie mouse-screen coordination and virtual on-screen ‘buttons’ while at the same time constructing an easy way into such interaction paradigms, usually via deployment of objects, images and structures familiar from pre-digital forms. Substantial design effort was required to create a context in which an untrained member of the public could be drawn into a work which was framed and constrained in such a way that in which they could be expected to do something which wasn’t completely ‘out of the ballpark’, while simultaneously not being tediously instructive and didactic. I well remember stories from the early 90’s such as that of the young woman driven to tears by the computer mouse. She had reasoned, perfectly reasonably, that mouse should ‘face’ the screen, ie with the ‘tail’ toward her, which inverted all her actions with respect to cursor movement. But within a decade, the community had thoroughly acculturated to the screen/keyboard/pointer, desktop paradigm. Since then, interaction design, in the arts and elsewhere, has bifurcated between that deploying well known interaction paradigms (which are at this point ‘intuitive’) and that concerned with novel modalities. In the latter case, artists must engage a meta-design task of introducing the user to the special modalities of the work, without making such introduction itself laborious or instrumental. No one wants to do a tutorial for an artwork.⁴

The fundamental requirement of interactivity is to correlate in a meaningful way, data gathered about the user, with output. Without this there is no perception of interactivity. Meaningful interaction requires that several functions be correct and coordinated correctly. These include correct choice of sensors which capture the right modality of data, correct interpretation of the data, correct associative systems, and the production of output whose content, location and dynamics makes sense to a user as a meaningful

⁴ I use the term ‘user’ here and in what follows to refer to anyone interacting with an interactive artwork. Many including myself have deplored (the instrumentality of) the term, and have sought alternatives and coined neologisms, but alternatives have been clunky and have not achieved general acceptance.

correlate of their own behavior. But this does not mean that only literal or instrumental modalities can be meaningful. Temporal immediacy permits aesthetic deployment of sleight of hand. In the world, if I knock a glass and it falls to the floor splintering, I assume a physical and temporal causality. Assumption of causality based on temporal order can be designed-in and exploited in interaction design. As in montage in film, diverse elements and events can be connected by temporal sequencing.

Conventional interactive schemes tend to fall into two camps – ones that are simple and therefore easy to understand, and which therefore either become familiar and automatic or boring, and others which are so complex as to be baffling and cause all but the most dedicated to fatigue. By ‘conventional’ I mean that the interactions themselves are hardcoded. This is a kind of meta-stability. To move beyond this stalemate, in 1997, I proposed the idea of a dynamical ‘autopedagogic interface’ – an interface which observed and learned from its user(s) how well they understood the system, and ramped up complexity gradually as a result of constant monitoring.⁵ This kind of adaptive technology harks back to cybernetic precepts but has rarely been pursued in artwork. A work which has pursued this to some extent is *Performative Ecologies* by Ruari Glynn (discussed below).

Aside from the trivially Pavlovian modality of the ‘virtual button’ (press the button and get the reward/food pellet) what are the key interactive modalities? In installation and robotic work, very few examples exceed a minimal autonomous agent modality, a zoomorphic ‘puppy paradigm’, of approach and withdrawal, trust and fear. This is always beguiling – for a while. Is the charm of this modality somehow ‘natural’ to us as humans, perhaps hardcoded into our DNA as parenting animals? This question opens a field of inquiry at the intersection of neuroethology and interactive aesthetics. Whatever the case, the next question is how to move aesthetic development of the field beyond this biological or cultural ‘ground zero’.

⁵ See my *Agents as Artworks*.

At the outset, our ability to predict, and find predictable, behaviors of digital systems, is rooted in embodied experience in the world. We are first and foremost, embodied beings subject to materiality, gravity etc. We interact with living and non-living entities, and other humans. We understand digital environments on the basis of extrapolations upon such bodily experience based prediction. It is seldom remarked that a significant aspect of much development in the arts attended to dynamic embodied interaction, a normal aspect of human being-in-the-world which was conspicuously poorly addressed in conventional sit-at-a-desk computer systems.

In the contemporary context, this situation has changed in two ways. Firstly interface technologies are far more diverse, complex and subtle. One device, the embedded miniaturised accelerometer has become ubiquitous and has contributed hugely to these changes. Secondly, and more subtly, the first generation to have lived with digital devices during infancy is now approaching adulthood, and these people's neurology has, to some extent, formed and developed around such systems. That is, the metaphors and behaviors of digital systems have generated isomorphic neurological structures – digital metaphors instantiated at the level of cellular biology.

In what follows I discuss several works of the period which stand, in my mind, as markers for significant moments in the development of interactive digital cultural practice. In the main the are works I have chosen, I have experienced directly, and in most cases, I am privy to both the goals of the artists and the internal workings of the systems. I include three of my own works here, because they were immediately engaged in the development of ideas and approaches in question, but also because I happen to know the motivations, development processes and internal workings of these works intimately.⁶

There are numerous other works one might usefully discuss. It is a regrettably fact that, due in part to rapid changes in the technologies and the absence of appropriately skilled and resourced staff in appropriately set-up collections, I estimate that 75% of this work is

⁶ Discussion of these works can be found at www.ace.uci.edu/penny (works)

lost entirely, and only a very small percentage of it persists in working form. It is sobering to reflect that a photograph 100 years old, if kept dry, is perfectly accessible to view, but the vast majority of commercial digital systems only a decade old are unusable, to say nothing of the many custom systems. Occasionally, a heroic effort is conducted to rescue such work before it decays completely. The exhibition *Eigenwelt der Apparatwelt*, curated and restored by Woody Vasluha for Ars Electronica in 1992, is one such case.⁷

Conspicuously, I here avoid discussion of desktop-based works. My reason for this is principled. It has always been my opinion that such work, whatever its creative and experimental value, on the level of interaction and interface, took too much for granted. That is, by willingly adopting the constraints of the desktop interface, big questions were avoided and solutions appropriate for to sedentary mathematico-symbolic deskwork were uncritically adopted and this had the effect of profoundly perturbing and constraining creative possibilities.

Interaction, embodiment and gesture

Deploying machine vision for interactive artworks was pursued by several artists, with David Rokeby's *Very Nervous System* being a precursor. *Very Nervous System*, first shown at Venice Biennale in 1986, responded to the dynamic of user movement with stereo audio. Rokeby notes: *The installation is a complex but quick feedback loop. The feedback is not simply 'negative' or 'positive', inhibitory or reinforcing; the loop is subject to constant transformation as the elements, human and computer, change in response to each other. The two interpenetrate, until the notion of control is lost and the relationship becomes encounter and involvement. ...The installation could be described as a sort of instrument that you play with your body but that implies a level of control which I am not particularly interested in. I am interested in creating a complex and resonant relationship between the interactor and the system.*⁸

⁷ *Eigenwelt der Apparatwelt*, *Pioneers of Electronic Art*, Ars Electronica 1992 exhibition catalogue, 1992

⁸ <http://homepage.mac.com/davidrokeby/vns.html> accessed 28 Dec 2010

The fact that video cameras and realtime video are now a normal part of contemporary computers and gaming systems obscures the fact that into the late 90's, machine vision was regarded as a hard technical research problem. This makes Rokeby's achievement all the more remarkable. VNS ran on an apple IIe, a machine which would have struggled to render a 640x480 graphic frame in 24 hours. He managed with its tiny processor to do both real-time machine vision and realtime stereo audio. He achieved this extraordinary result because, in the first instance, his project was clearly concept driven – he knew what he wanted out of the technology - and he had an adequately deep understanding of the analog and digital electronics and coding that he was able to pare off unneeded functions. While a conventional approach would analyse sequential frames pixel by pixel, laboriously identifying and labeling presumed relevant 'objects', with an artists education, David understood firstly that 'frames' are an utterly artificial construction inherited by digital systems from video and film, and that light values on pixels are not 'objects' in any sense.

Any amount of academic and industrial machine vision research still labors under the naïve conception that frames are anything other than a skeuomorphic convention, and that lines in images can be unproblematically associated with objects in a physical space. Computer science libraries and journals are replete with papers on topics like 'edge detection', in some cases the authors seem quite unaware that a video image depends on optics developed in film cameras, and cameras themselves were designed to implement the graphical perspective, a conventionalized geometrical system for representing spatial depth on a plane, the basis of which was laid by the arab mathematician Alhazen (al-Hasan Ibn al-Haytham) in 1021. There is nothing 'natural' about perspective, it is not the 'true' way to represent the world, human vision that has little in common with it.

David was interested in temporal bodily dynamics and recognized that variation through time was the data that was critical and pictorial resolution was more or less irrelevant. Color was therefore dispensable. In fact, David's 1968 'cameras' consisted of 64 cadmium sulphide light dependent resistors on the back of a wooden box, with a plastic

fresnel lens on the front (IMAGES). The resistors, being slow moving devices, effectively damped the system. David in fact added the values for the resistors, to produce one value per timestep, and tracked the temporal pattern of changes on that graph. The parsimonious elegance of this solution is characteristic of the technological solutions which technically adept artists of the day were compelled to realize due to the limited means available – due to the double constraint of the condition of the technology of the day and the limitations of art budgets.

VNS is a prime example of what I have referred to previously as ‘machine parsimony’ – an ethic of technology design which is elegant and economical – at the cost of being application specific. Such an approach is antithetical to the conventional commitment to ‘generality’ and general purpose tools, is profligate in its use of resources, and encourages a plug’n’play approach to coding which while emulating to look of purist modularity is antithetical to its spirit. In the context of digital cultural practices, the slippage in computer science discourse around this notion of generality is most unfortunate. While Turing’s mathematical formulation of the ‘general purpose machine’ has undeniable value in its context, the notion has, by some sort of elision, weirdly oozed into other frames of reference. This has as much to do with marketing rhetoric sleight of hand and economies of scale in the computer industry as it does any principled argument.

Of all the things I do in my life, only some of them map well onto sitting at a desk in front of a glowing surface, poking at buttons. Nor is this situation improved one iota when the context is miniaturised so the buttons are smaller than my fingers and I have to put my reading glasses on to look at the screen. Artists and artisans understand this – there is a tool for every job and a job for every tool. To the extent that a tool is general purpose, precisely to that extent it is horrible. A good tool makes an artisan more effective, but in the hands of a dolt, a good tool is ruined. So a good tool isn’t a good tool unless it is wrapped in a complementary context of skilled practice.

Around the same time as VNS, another Canadian artist (and a teacher of Rokeby) Norman White debuted his Helpless Robot (1987). Savagely funny, the Helpless Robot

has no motive power and its sensor suite is rudimentary. It depends on its verbal persuasiveness to entice humans to do its work for it. As a person is drawn into helping the helpless robot, the device becomes increasingly impolite and abusive, creating a situation from which the humiliated human helper must sheepishly escape. Under the hood, Helpless Robot it speaks over 500 phrases organised by emotional categories such as boredom, frustration, arrogance, and overstimulation. As such, it is an early example of affective computing, and defines goals of emotion modelling research which began in institutional contexts a decade later.

My own ‘Petit Mal – an Autonomous Robotic Artwork’ (begun in 1992 and first exhibited in 1995) undertook the task of building a robust autonomous machine for cultural purposes. I saw the device, technically, as a vindication of a reactive strategy. The device behaves robustly, with the public (albeit in a controlled environment) for 10-12 hours days. Socially, it elicits play or dancing behavior in users. Interaction is driven by curiosity and seemingly, a desire to pretend that the thing is cleverer than it is. People willingly and quickly adjust their behavior and pacing to extract as much action from the device as possible, motivated entirely by pleasure and curiosity. Interestingly, the only demographic who were unwilling to interact were adolescents.

Petit Mal implements a non-instrumental kind of ‘play’ which is quite incommensurable with conventional computer game logic. When stripped of its colorful monsters and futuristic weapons, computer game-play in the paradigmatic first person shooter is indistinguishable from the worst qualities of industrialized labor: constrained and highly repetitive tasks executed in social isolation, a tight harnessing of user and machine, rewards linked to high rates of production, to say nothing of the covert inculcation of military skills.⁹

⁹ Several gaming-partisans have taken me to task, saying ‘but game X is not like that’, or ‘such an analysis ignores aspects PQR which are culturally good’. It will also be asserted that such games are shaped by the market as well as by the makers who themselves are the product of a larger and older culture. I do not, in principle, dispute those objections,

Beyond Pages by Masaki Fujihata (1995) was a work which subtly and exquisitely merged the book paradigm with interactive graphics, held together by carefully crafted interaction design supported by not particularly adventurous technologies of the time – data projection from underneath combined with a tracking stylus for interaction. As one drags the stylus across the image of a large book displayed on a projection surface inset into a desk, pages flip. The high resolution sound samples synchronized with the image contrive the feeling that these are heavy, course pages. On each page an object is depicted, and stylus action moves or changes the object. A rock shuffles across the page, large crunchy bites are taken out of an apple by an invisible eater. Japanese characters are spoken. In an elegant set of jokes, a light switch in the book turns the lamp on the desk on an off. A door handle opens the door in the video image projected on the adjacent wall.¹⁰

As noted above, during this period, artist were (necessarily) at pains to demonstrate the new modalities of digital interaction by grafting them on to (representations of) understood artifacts and devices. After twenty years, as often as not, the tables are turned. It is the digital interface to which users are naturalised and the works serve as a window onto a preceding technology. It may not be long before users play with Fujihata's Beyond Pages to get a sense of what books were like.

A work of very different scale and historical reach is Rafael Lozano Hemmer - Displaced Emperors (1997). The projection installation took place on the multi-storey exterior of a Hapsburg villa in Linz Austria. As a user, equipped with a custom triangulating sonar tracker on the back of her hand, made a waving gesture in the direction of the castle, the image of a giant hand moved across the façade. This waving appeared to wipe the

but the fact remains that, for better or worse, such game-play is colored and constrained by the history of industrial labor and the development of sciences of man-machine integration for military applications.

¹⁰ http://www.iamas.ac.jp/interaction/i97/artist_Fujihata.html

exterior wall away, revealing period interior rooms. These room views were in fact taken in the Chapultepec Palace in Mexico City, the residence of the short-lived mexican Hapsburg dynasty. The work collapsed one physical location onto another, succinctly encouraging reflection of the historical peculiarities of the colonial period.

The role of epistemic or performative action in interaction.

It is useful to distinguish between work in which the dynamics of interaction was itself the subject and work in which the dynamics of interaction were conceived as a means to an end which was primarily found in the ‘content’ of the work – as if interaction dynamics were not always part of the ‘performative’ content. We can make a distinction between interface and interaction modalities are deployed as a mechanism for exploring ‘content’, and modalities which themselves contribute to the accumulated meaning or experience of the work. We might say that content-centric interactives are retrogressive, and simply articulate the representational idiom of painting, film and video, while works in which the dynamics of interaction are themselves the ‘content’ of the work occupy a more progressive position.

In Rafael Lozano Hemmer’s *Displaced Emperors* the gesture of the swipe of an outstretched hand wipes the façade off the palace, revealing (images of) the rooms inside. The façade, in both a real and metaphorical sense, is destroyed, performatively implicating the user in a violent and revolutionary act. In the development of an aesthetics of interaction, there is potential for the notion of ‘epistemic action’ developed by Kirsh and Maglio to be extended to include such embodied and gestural engagement in works of this sort.¹¹ Pickering’s juxtaposition of representation and performative idioms is likewise useful.¹²

Fugitive (Penny, 1997) deployed a custom machine vision system for detecting bodily movement and large gesture of a user in a 10m circular space. This behavior drove

¹¹ Kirsh and Maglio, *Epistemic Action*

¹² Pickering, *The mangle of Science*

selection of video from a (local) video database and sent it to a motion- controlled video projector which displayed the images in varying locations on the wall of the cylindrical room. My goals in the interaction scheme of Fugitive were precisely to resist the tendency to a scopophilic focus on the image, but rather to draw the attention of the user to the temporal continuity of their own embodiment. This was in part motivated as a critique of Virtual Reality. In conventional VR, the disembodied gaze had the ability to 'move' on preordained paths within a prestructured architectonic environment. In fugitive, the continuity was the temporal continuity of the users embodiment, or more correctly kinesthetic awareness. Virtual scenes arose and collapsed on the basis of that continuity.

Artificial Life, autonomous agents and virtual ecologies

Another work which inventively addressed concerns of the period is El bal de Fanalet/ Lightpools, by Narcis Pares, Roc Pares and Perry Hoberman, (1998). El bal de Fanalet/ Lightpools combined sonar-based tracking¹³ and interactive artificial life-based graphics with artifacts derived from Catalan popular culture. The fanalet is a paper lantern used in a traditional Catalan dance festivity, and in this case it also contains the sonar tracker. One of the issues of concern to artists was the limitation of conventional computer platforms and sensor systems to single user application. There was much interest in devising viable multi-user systems which attend to small and large group social dynamics so important in human interaction. In addition, Pares, Pares and Hoberman were concerned to implement a world of multiple interacting organisms in the 'virtual' realm. This realm was 'exposed' in the 'lightpools' associated with each fanalet, in the way that at night a lantern might illuminate an area of a fishpond. Movement of the fanalet by the user encourages movement of the virtual creatures. The signification of the lantern is deployed metaphorically to conceptually join the physical world inhabited by the users with the virtual world 'under the floor'. The glue that hold this metaphor together is real

¹³ the GAMS triangulating sonar sensor develop by Will Bauer and Rafael Lozano Hemmer, also deployed in Displaced Emperors.

time integration of user gesture with projected content, and new behaviors emerge when users merge their lightpools.

Work such as *El bal de Fanalet* and *Petit Mal* reflect a general interest among the community at the time in the emerging field of Artificial Life. ALife marked a radical swing in computation and AI circles from symbolic approaches to systems modelled on biology, self-organising systems and emergent complex order. Colonial animals- slime molds, sponges, termites ants and bees became interesting as models of emergent complex behavior from simple elements, and Cellular Automata were seen to model such behavior computationally. Evolutionary, genetic and ecological metaphors and methods replaced analytic logic (Holland, Ray). Neo-neural-net connectionism and Darwinian computational environments (genetic algorithms) demonstrated significant success (Sims), as did bottom-up and reactive robotics (Brooks, Steels). In the arts, there was a remarkable flowering of new practices based in these ideas.¹⁴

My own work *Sympathetic Sentience* (1996) was inspired by such developments. My goal was to build a minimal physically instantiated system of multiple communicating units which demonstrated emergent complex behavior. *Sympathetic Sentience* was constituted by twelve independent, more or less identical, wall mounted sound producing devices. These communicated in a serial loop via custom infra-red hardware. Alone, each unit could emit only an occasional chirp. But in a loop, each device voiced a constantly changing but acceptably ordered rhythm and melody, and the chirp/silence ratio stabilized but fluctuated around 50%. That is, the system on its own generated complex and constantly changing output and was self stabilizing – it never went silent or 100% on. The system achieved this result with little but a simple astable chirp generator, an XOR gate and a short time delay in each unit. The system did have minimal, suppressive ‘interactivity’. A user could unknowingly interrupt an IR beam and thus impose a silence in the melodic passage, which would then slowly fill up again. But the focal concern was not with human agency, but with the agency, autonomy and creativity of a minimally complex system.

¹⁴ See my *Twenty Years of Artificial Life*.

A more recent work which combines emotion modeling with embodied interaction is Sniff by Karolina Sobecka and Jim George (2009). Sniff is member of the Alife genus of on-screen interactive semi-autonomous agents. Sniff is a lively pup, or rather, a behavioral portrait of a lively pup rendered on a large backprojection screen. Sniff interacts with visitors via machine-vision based sensing. Sniff is rather finely physiologically modeled and 3D animated, but in a deft artists touch, Sniff eschews the baroquity of texture maps, and is presented as a fine-resolution polygonal model in white lines, in a featureless black space. The contrast between the verisimilitude of Sniffs behavior and the abstraction of its visual representation heightens the persuasiveness of its physiological and behavioral modeling. Sniff is a rather subtle canine behavior-portrait, it will identify with one of several visitors a primary interactor, and has a sophisticated behavioral memory.¹⁵ (IMAGE)

Performative Ecologies by Ruairi Glynn is a more abstractly mechanical work which attempts to realize embodied agents which learn from their environment and improve their behavior consists of three identical, exhibitionistic and somewhat insecure motorized sculptures which dance for their supper, as it were. Each has a tail part - a motorised illuminated rod which it can turn and light up variously, and a head part, an infra-red video camera on a motorized neck. When functioning as designed, each unit will locate a visitor, using face recognition software, and will perform a dance for her with its tail, all the while monitoring the attentiveness of the visitor, using gaze tracking. The longer the visitor attends, the better the dance scores. Later, using genetic algorithms, these devices develop new dances from the best scoring previous dances, to be tried out on the next days visitors. In a limited way, these devices moves beyond the 'look-up table' paradigm of interaction where all behavioral possibilities are pre-scripted, to a mode which can truly produce novelty or surprise. (IMAGE?)¹⁶

¹⁵ <http://vimeo.com/6400266>

¹⁶ Sniff and Performative Ecologies were included in Emergence, and show of artificial Life art curated by Simon Penny and David Familian at the Beall Center for Art and Technology, University of California Irvine, Dec2009-Apr2010. Regrettably Performative Ecologies did not function as designed during the show.

Autistic and solipsistic and performative machines

In recent years a new class of devices has arisen, perhaps partly as a perversely witty response to preoccupation with interactivity. These devices possess complex behavior and are so autonomous as to have no connection with human viewers. In such works, the visitor engages in a conventional mode of passive observation of an autonomous machine negotiating its environment, a more biologically, ecologically based model.

Giver of Names (David Rokeby, 1998) presents as novel a reading of artificial intelligence as VNS did of machine vision. Giver of Names speaks cryptic sentences produced by a neural net-like metaphorically-linked associative database of objects, ideas and sensations, driven by data derived from a machine vision system which views arbitrary objects placed on an empty pedestal. These utterances are fed back in to the system, generating a stream of solipsistic musings which by turns sound poetic, philosophical or like the ravings of an obsessing schizophrenic. Here the preoccupation is not with interactivity, but with the behavior of a self-reflexive autonomous system.

Two more recent works are similarly solipsistic and exhibit a resurgence of a minimalist/formalist sculptural aesthetic. They also have in common a commitment to materiality and to integrating electrophysical realities as part of the larger computational system. That is, the elegance of their formalism has extended into machinic/performative dimension of their existence.

Der Zermesser by Leonhard Peschta (2007) is a large but minimal geometrical robot which engages in a sensitive relation with architectural space, expressing its response as perturbations of its tetrahedral form. One might call it 'architaxis'. Der Zermesser works at a slow, non-human timescale, like a mollusc on a rock. The tetrahedron, the first platonic solid, the strongest polyhedron, is an icon of engineering efficiency, and is also manifested in a myriad of biological forms, evidence of the effectiveness of evolutionary design. Der Zermesser captures this doubleness as an adaptive geometry. The formal coherence and elegance of Der Zermesser is carried through to its electronic aspects - the geometrical nodes are also motor, sensory and computational nodes.

The Conversation, by Ralf Baeker (2010) is a self-referential and homeostatic colonial machine - a model of a colonial organism rendered in electrophysical machines.¹⁷ The Conversation is a closed-loop computational system combining electro-mechanical, analog and digital electronic components, presented in an elegant and minimal sculptural form- a ring made up of a 99 solenoids. The solenoids pull on wires connected to three concentric rubber rings in the center of the device. With a machine parsimony based in an understanding of electro-physical phenomena, Baeker monitors fluctuations in the magnetic pull of the solenoids via their current consumption (where others might have added an array of sensors). A floating metal ring - a platonic apparition, paradoxically pulsating with the vibrancy of the living. If the metal ring is the cell wall, the three fluctuating red rubber rings define the nucleus, with radiating strings relaying tensions back and forth between the two. Crucially, the physical system is not 'driven' by code, but in cybernetic sensibility, the moment by moment condition of the material array drives resonating cycles of oscillations and dampings within the system.

Conclusion

During the 'heroic period', motivating questions were of the order of: 'how can we deploy computational capability in artworks?' and 'how can we integrate computation with material, sensorially immediate practices?' The problem of interaction, like the problem of computer graphics and of machine vision, and other technical challenges of the 90s, is now effectively solved. Culturally, the novelty of the scenario of the machine which responds to a user in real time has clearly worn off. In digital cultural practices, exploration of the modalities of interaction is fairly complete, though there is always room for inventive exploration of the subtle complexities of the poetics or aesthetics of interaction. Increasingly, it is interaction between machines and machine systems, and between machines and the world which offers opportunities for exploration.

¹⁷ http://www.no-surprises.de/the_conversation

For two decades, the computational has been more or less ‘pasted on’ to artifacts and social structures. And with the technology, the rhetoric of cognitivist computation has also been pasted on. Works like *Giver of Names*, *Zermesser*, *The Conversation*, demonstrate the integration of machinic/performative dimensions into an overall aesthetic and theoretical approach. In their integration of materiality and computation, these works reject a dualist computationalist separation of software and hardware, information and matter, control and action. For me this signals a new maturity the cultural and theoretical grounding of work of this kind, where ‘interactivity’ is subsumed into a wider field of autonomous behavior.

In our current era of ubiquitous computation, the universe of live data which was once called ‘the virtual’ is increasingly anchored into physical and social context via a diversity of digital commodities, whose technologies, techno-social structures and modalities of interaction were workshopped and prototyped in ‘media arts’ research and elsewhere over the past quarter century.

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