The Aotearoa Digital Arts Reader
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Open Interactions

Karl D.D. Willis

Using the term 'interactive' to describe anything never seems to communicate much. At best it might entail a relationship with computers, games, or perhaps the Internet. At worst we could be talking about a doorbell—press the button and the bell chimes. The vagueness associated with the term interactive is not new, by some accounts stemming from the proliferation and diversification of all things 'interactive' in the 1990s.[1] Artists such as Rafael Lozano-Hemmer have described the word as 'exhausted' and avoided using it, while disciplines such as architecture are seeking to re-examine its meaning through the current wave of interactive architecture.[2]

So when exactly does something become interactive? Speaking in 1957, Marcel Duchamp suggests the participation of the spectator is evident in the art process at large:

> *All in all, the creative act is not performed by the artist alone; the spectator brings the work in contact with the external world by deciphering and interpreting its inner qualifications and thus adds his contribution to the creative act.*[3]

While such cognitive interaction is undoubtedly present, the physicality of interactive art is in many ways what separates it from a given painting or sculpture. Shifts in the broader context of contemporary practice have undoubtedly influenced interactive art, as theorist Jack Burnham noted at the end of the 1960s: "we have already seen in happenings, kinetic art, and luminous art some premature attempts to expand the art experience into a two-way communication loop."[4] Performance works such as Fluxus artist Yoko Ono's *Cut Piece* (1964) in which an audience was invited to snip off her clothing piece by piece, make no explicit use of technology but are undoubtedly 'interactive' in the way they require participation from an audience.

Often cited is the Massachusetts Institute of Technology (MIT) Media Labs' *working definition* of interactivity: "Mutual and simultaneous activity on the part of both participants usually working towards some goal but not necessarily."[5] The model suggested here is described by MIT's Andy Lippman as "a conversation versus a lecture." The metaphor of conversation goes some way to defining the unique characteristics of interactivity: it is responsive, interruptible, and two-way.

Lippman cites the MIT-developed *Aspen Movie Map* as an example of conversational interactivity. This system enabled the user to take a virtual tour of Aspen, Colorado by navigating their way along a map of its streets. Lippman makes special note of the interactive 'granularity'—the size and abundance of the individual elements—in contributing to the interactive experience. For the *Aspen Movie Map*, this equates to giving the user the impression that there is an 'infinite database' of elements, that at any given moment they can veer off their current course and tour some other part of the city.[6]

This concept of interactive granularity, which describes the size of the individual system elements, is of key importance in defining what I call 'open interactions'. Open interactions consist of an even finer degree of granularity than the *Aspen Movie Map*, often using mere pixels, sound samples, words or letters. Participants interact with such open systems by arranging these elements, for example: pixels into drawings, sound samples into rhythms, or letters and words into texts. Open interactions result in highly participatory creative experiences, where those engaged with the work can interact in an unstructured way as opposed to navigating heavily authored content or narrative formats.

1. Erkki Huhtamo, "Seeking Deeper Contact: Interactive Art as Metacommentary," *Convergence* 1, no.2 (1995): 81.
2. See Usman Haque, "Distinguishing Concepts: Lexicons of Interactive Art and Architecture," in *Architectural Design, 4dsocial: Interactive Design*, ed. Lucy Bullivant (London: John Wiley and Sons, 2007), 24 – 31; also Alex Adriaansens and Joke Brouwer, "Alien Relationships from Public Space: A Winding Dialog with Rafael Lozano-Hemmer," in *Transurbanism*, ed. Laura Martz, (Rotterdam: NAI Publishers, 2002), 138 – 158.
3. Marcel Duchamp, "The Creative Act," *Art News* 56, no.4 (1957): 29.
4. Jack Burnham, "The Aesthetics of Intelligent Systems," in *On the Future of Art,* ed. Edward F. Fry, (New York: The Viking Press, 1969), 99.
5. Stewart Brand, *The Media Lab: Inventing the Future at MIT* (New York: Penguin, 1988), 46.
6. Brand, *The Media Lab*, 49.

Mapping Interactivity

Artist-researcher Douglas Edric Stanley addresses the evolution of interactivity in what he sees as a "move away from specific interactive objects as an end-all, and the emergence of a culture of software, instruments, and platforms for artistic creation."[7] To this end Stanley has created what he labels a *moral compass* to map such systems for artistic creation:

> *Reactive—Automatic—Interactive—Instruments—Platforms*[8]

Stanley's use of this scale is linked to his research on the use of algorithms for artistic creation. However it is possible to reinterpret the scale as a means to locate interactive works based on their interactive *granularity*. Coarser granularity, with larger individual elements, occupies one end of the scale, labelled by Lippman as merely *selective* rather than truly *interactive*, with the user choosing from a finite number of presets. On the other end of the scale, finer granularity provides smaller individual elements with which the participant can begin to construct and create in diverse ways.

A similar paradigm can be found in computer science, where programming languages are referred to on a scale from low to high level based on the degree of abstraction between the programmer and the machine. Low-level languages offer great control, but at the same time require attention to huge amounts of detail when programming. High-level languages automate many of these lower-level tasks and consist of larger blocks of code for specific needs. In reinterpreting Stanley's scale, it is worthwhile to take a closer look at each category to clarify how it relates the notion of interactive granularity.

Reactive Systems

Interactivity is often associated with control structures. Architect Usman Haque and researcher Paul Pangaro label such interactive systems the "one-way, reactive interaction model", which they suggest:

> *…got a firm foothold in the minds of interactive designers (in both art and industry) because it provided short-term results that were easy for people to grasp and use. In other words, because it relies on a causal relationship between 'human' and 'machine' ('I do X, therefore machine does Y back to me'), people are very quickly able to understand the system.*[9]

The field of Human-Computer Interaction evolved according to a model of user as master and computer as slave; a far cry from interactivity as a conversation. Artist Jim Campbell addresses this relationship:

> *The computer industry's goal of making computers and programs smarter is simply to make computers more efficient at being controlled by the user to get a job done. Why should they do anything else? This is generally what we want*

7. Régine Débatty, "Interview with Douglas Edric Stanley" *We Make Money Not Art,* 2006. http://www.we-make-money-not-art.com/archives/008594.php
8. Débatty, "Interview with Douglas Edric Stanley."
9. Usman Haque and Paul Pangaro, "Paskian Environments," paper presented at *Game Set and Match II*, Delft, The Netherlands, 28 March 2006.

> *computers for: we want them to be passive slaves. One can see this in the software, hardware and interfaces that are currently being used. This model is fine until it collides with art.*[10]

A form of simple responsiveness through a branching series of decisions is now omnipresent, for example in automated teller machines, mobile phone interfaces and websites. From the outset, artists such as Lynn Hershman have sought to experiment with this form of interactivity. Her installation *Lorna*, developed from 1979 onwards, is a video-based non-linear narrative that predates the popularisation of media such as LaserDisc, CD-ROM, and later DVD media. In *Lorna*, visitors interact with a monitor via a remote control, navigating through the story of a woman alone in her apartment with only her television for company. In providing a series of choices programmed by the artist, *Lorna* operates reactively, a paradigm of interaction described by Lozano-Hemmer as akin to a "top-down 1-bit trigger button—you push and something happens."[11] In Hershman's work this control structure is problematised by the character *Lorna's* own lonely dependence on (and control by) the television that provides our view into her world.[12]

Automatic Systems

Automatic systems function without interaction, relying on a set of author-determined rules or algorithms to run independently. Lacking any physical interaction, automatic systems inhibit the user from making any choices that can directly influence the form of the artwork, however automatic systems are capable of surprisingly complex behaviour. Simon Ingram uses off-the-shelf Lego robotics to build self-creating *Painting Assemblages*. Attached to the gallery wall, clutching a brush, the machine's 'paint head' moves over the canvas on an X Y rack and pinion system, dipping into its gluggy Lego paint pot before making a stroke. Over the course of the painting's exhibition, the robot renders an algorhithmically-described T square fractal. Although the format of the finished work is pre-determined, the sequence of brush strokes and decisions on their length and density are randomly generated on the fly, contributing to the painting's complex visual field.[13]

Interactive Systems

Over a decade on from Hershman's early experiments with branching narrative structures, interactive CD-ROMs reached mass audiences in the 1990s. Such projects typically ported *old* media into *new* media; reducing interactivity to a mere gateway to the 'real' content inside. Andy Polaine, co-founder of art collective Antirom, notes that "from navigational menus to videogames, interactivity is often part of an interface to other content. This ignores the experience of the moment of interaction and relegates it to a mechanism of control at best and something to be mastered and 'got through' at worst."[14] Antirom chose to react against such interfaces, instead creating works where "the interface was the content and the purpose of the interaction was the experience of the interaction."[15] This approach allowed Antirom to explore interactivity without being tied to models such as cinema or literature.

1: Simon Ingram, *Painting Assemblage No. 6, 2007*, 2400 x 2400mm, courtesy the artist and Gow Langsford Gallery, Auckland. *Far right:* The painting at 10, 50, 100, 200, 2,000, 10,000 and 18,000 strokes. Simon Ingram's paintings use off-the-shelf Lego robotics to build a work that paints itself. The robot painter bolted onto the stretcher moves on a rack and pinion system, clutching its brush as it travels over the work's surface, dipping it periodically into its dripping Lego paint pot. Over the course of the exhibition, the robot executes an algorithmically-described T-square fractal. Although the format of the finished work is pre-determined, decisions on the length and density of the brushmarks are randomly generated on the fly, contributing to the complex visual field of the painting.

10. Jim Campbell, "Delusions of Dialogue: Control and Choice in Interactive Art," *Leonardo* 33, no.2 (2000): 133.
11. Adriaansens, and Brouwer, "Alien Relationships from Public Space."
12. Gabriella Giannachi, "Gabriella Ginnachi introduces Lynn Hershman Leeson," 2007. http://presence.stanford.edu:3455/LynnHershman/264
13. Stella Brennan, email interview with artist, 19 December 2007.
14. Andrew Polaine, "The Playfulness of Interactivity," paper presented at the *Fourth International Conference on Design and Emotion*, Middle East Technical University, Ankara, Turkey, 12 July 2004.
15. Polaine, "The Playfulness of Interactivity."

fig. 1

Just as interactivity can be limited by the paradigms of old media, a technologically determinist notion of interactivity elides other factors. Media archaeologist Erkki Huhtamo notes:

> *Most people are content to define interactive media as a certain kind of technology, without considering the uses to which it is put. ... The problem lies in the failure to grasp the fact that media products cannot be defined as interactive merely because they use or have access to certain kinds of hardware and software. The crucial question is one of contextualisation.*[16]

This technological focus ignores the all-important social and aesthetic context of interactive art. Rather than the technological make-up of the system itself, how the participant interacts and the subsequent results of that interaction should remain the point of focus.

Instruments

Instrument-like art systems have a level of granularity that enables the raw elements of the system (sound samples or pixels as the case may be) to be combined to create a virtually unlimited range of output. However rather than focus solely upon the creation of an artefact, the emphasis is on the interactive experience that develops.

In my own work I have created instrument-like art systems, most notably with the interactive drawing installation *Light Tracer*. *Light Tracer* invites the participant to write, draw and trace images in physical space using a series of light sources. The motivation behind the project was to make something that would allow others to create, leaving how the system is used up to participant.

With no pre-existing content provided, all imagery must be created from scratch by either drawing with a light emitting device (penlights, cellphones, lighters etc) or tracing physical objects with brighter lights such as a camera flash. Participants decide on both the tools they use and what they create—imagery ranging from impassioned Hezbollah slogans to trivial tic-tac-toe games.

Another project I have developed in collaboration with Dr. Ivan Poupyrev at the Sony Computer Science Laboratories in Tokyo is *TwelvePixels*, a drawing system for mobile phones.[17] The interface uses only the twelve keys of the handset to create simple pixel-based imagery. The underlying interface maps the conventional mobile phone keypad to the onscreen grid. Using the directional keys, the size and position of the drawing area can be changed to allow the creation of incrementally smaller pixel-cells.

Rather than attempting to re-engineer existing drawing interfaces on the mobile phone, the project aims to develop new techniques that are uniquely suited and native to the phone itself. Using this instrument-like system the possibility remains to develop a new style of imagery and expression that is unique to the mobile phone.

Platforms

As artists evolve along Stanley's scale towards *instruments* and *platforms* they move away from one-off interactive objects, towards broader structures for creation. David Rokeby's interactive sound installation *Very Nervous System* (1986-1990) is one such example of an artwork that was subsequently developed into a general software package called *SoftVNS*.[18] Users of *SoftVNS* can now

16. Huhtamo, "Seeking Deeper Contact," 87.
17. Ivan Poupyrev and Karl Darcy Daniel Willis, *Twelvepixels*. Mobile phone drawing system. Tokyo Japan: Sony Computer Science Laboratories, 2007. http://12pixels.com
18. David Rokeby, *Softvns 2.0*, 2002. http://www3.sympatico.ca/drockeby/softvns.html

2: Karl D.D. Willis, *Light Tracer*, 2005, interactive installation (http://lighttracer.darcy.co.nz/).
3: Ivan Poupyrev and Karl D.D. Willis, *TwelvePixels*, 2007-2008, mobile phone interface, Sony CSL ©2007 (http://12pixels.com/).
4: Nao Tokui and Karl D.D. Willis, *Sonasphere*, 2003-2004, generative audio-visual application, screenshot (http://www.sonasphere.com/wp/).

fig. 2

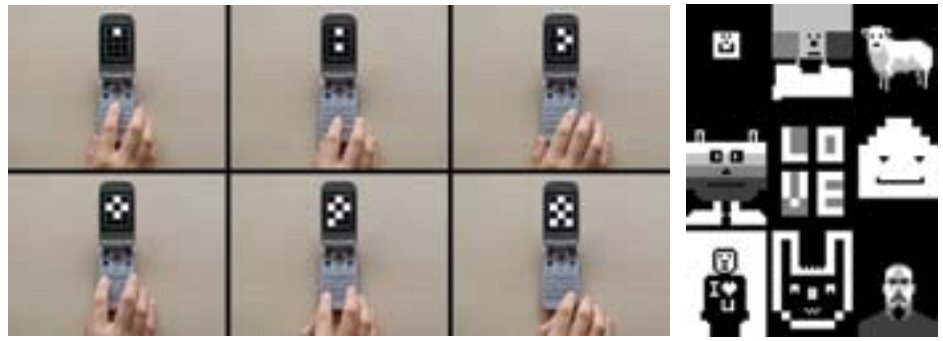


fig. 3

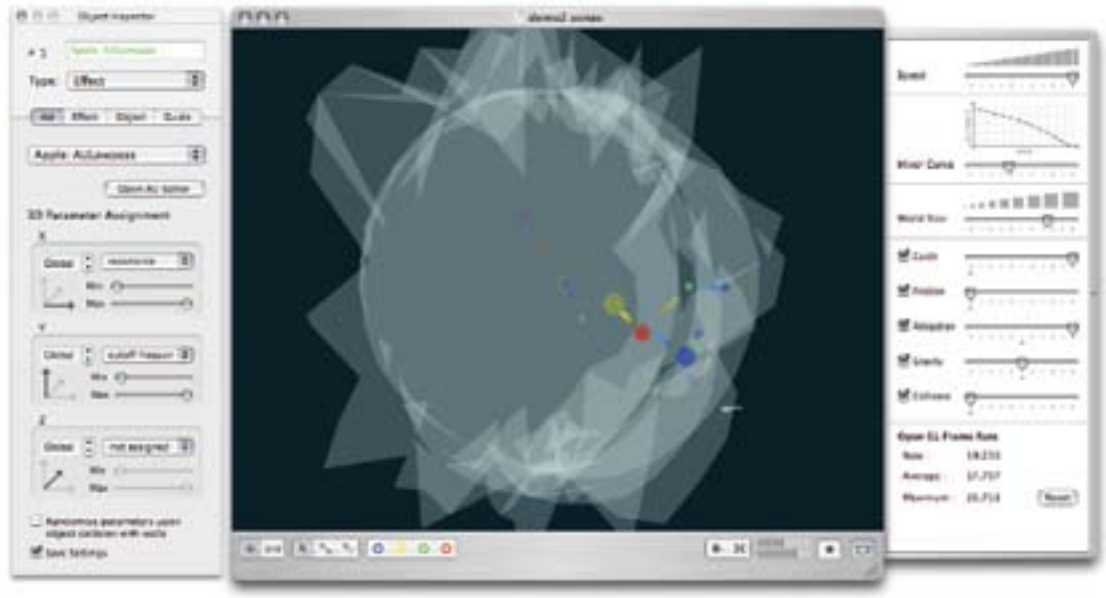


fig. 4

utilise the same computer-vision-based technology created by Rokeby in their own works.

Perhaps the best-known instance of artist-developed software spawning further artistic creation is the 2005 Prix Ars Electronica Golden Nica recipient *Processing* (2001) by Benjamin Fry and Casey Reas. *Processing* is an open source programming language and environment that enables artists and designers to create and control image, sound and other elements using accessible yet powerful programming functions.

Emergence

To extend Stanley's scale beyond *instruments* and *platforms*, it is useful to again frame interactivity as a conversation that gives weight to both the participant and the system. In a real life context Haque and Pangaro suggest the most productive conversations we have with others are generative, leading to new perspectives and actions.[19] But how exactly can we 'converse' with computers in such a way?

From 2003 to 2004 I was involved in the development of an audio application created by Nao Tokui, which attempted to address this question. *Sonasphere* implemented aspects of complex and chaotic systems into an audio production and performance context. The software acts as a virtual three-dimensional environment with nodes representing audio samples, effects, and mixers. By loading an audio file into a sample node then connecting it through an effect node to a mixer node, a network is formed that applies the given effect and plays the audio file. Nodes interact with each other in accordance with the virtual physics of the environment, which can be modified by the user. Relationships can be mapped out between the nodes, for example the Z axis of an audio sample node can be mapped to the 'resonance' setting of a 'low pass' effect, so that the deeper the node moves into the virtual space, the more resonance is applied, and the sound changes dynamically.

As the number of nodes increases, *Sonasphere* starts to exhibit characteristics of a chaotic system. While users contribute their own audio samples and effects, in such a chaotic environment they are unable to exert full control over the system. Tokui, himself a DJ, producer and musician, speaks of the desire to create moments of inspiration when interacting with computers and to apply the methodology of generative systems to a wider creative context.[20] *Sonasphere's* uses vary from live performance to the creation and processing of audio samples.

For interactive artworks, rather than one-off transformations of input into output data, the focus is on a loop of constant feedback and perpetual transition. To move beyond simple action/reaction structures toward more generative forms ultimately extends into the broader domain of emergence and machine creativity. Neuroscientist Peter Cariani notes:

> *The pragmatic relevance of emergence is intimately related to Descartes' dictum: how can a designer build a device which outperforms the designers specifications? If our devices follow our specifications too closely, they will fail to improve on those specifications. If, on the other hand, they are not in any way constrained by our purposes, they may cease to be of any use to us at all. Thus, the problem of emergence is the problem of specifications vs. creativity, of closure and replicability vs. open-endedness and surprise.*[21]

19. Haque and Pangaro, "Paskian Environments."
20. Nao Tokui, "Sonasphere," seminar presented at Auckland Art Gallery, Auckland, 8 December 2004. http://www.sonasphere.com
21. Peter Cariani, "Emergence and Artificial Life," in *Artificial Life II*, ed. Christopher G Langton et al. (Santa Fe: Santa Fe Institute of Studies in the Sciences of Complexity, 1991) 776.

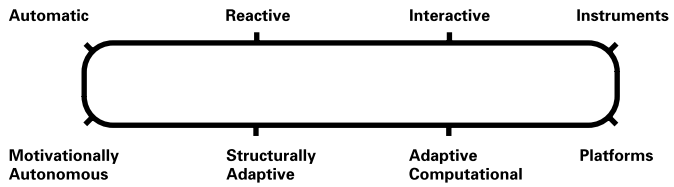
To produce emergent properties from a machine-based system an optimum level of autonomy is necessary. Within the field of computer games, the work of game designer Will Wright is a notable example of managing the balance of specification to allow for further creation. Wright speaks of the simple underlying cellular automata rules behind the ground-breaking city building game *Sim City*.[22] Despite the simplicity of the rules pertaining to such elements as crime, traffic, and pollution, Wright noted complex emergent phenomena such as urban gentrification evolving. Rather than being hard-coded into the game system, these emergent behaviours evolved through user interaction, capturing the "something for nothing" feeling of emergence.[23]

Adaptive Devices

Cariani's research into adaptive devices has relevance for interactive systems seeking to exhibit more complex behaviour.[24] He describes *adaptive computational devices* capable of altering their computational parts based on their performance. A learning mechanism and evaluation criteria are required to document past interactions, judge performance, and make subsequent adjustments. Douglas Bagnall's *Filmmaking Robot* is an example of a computationally adaptive system that captures live video footage of its environment and edits films from this raw data. The robot's editing choices are based on a set of evolving criteria, ranging from initial training of the robot's 'preferences' with Impressionist paintings to heuristics that identify novel compositions from its memory.[25]

Structurally adaptive devices are capable of constructing sensors and actuators based on their performance. In the late 1950s cyberneticist Gordon Pask created and experimented with an electrochemical device capable of growing its own sensors. Using an aqueous ferrous sulfate/sulphuric acid solution Pask developed an 'ear' that could be trained over half a day to distinguish between several sound frequencies.[26]

Beyond these could be *motivationally autonomous devices* capable of establishing their own performance-measuring criteria: "Such devices would not be useful for accomplishing our purposes as their evaluatory criteria might well diverge from our own over time, but this is a situation we face with other autonomous human beings, with desire other than our own."[27] With *motivationally autonomous devices* interactivity comes full circle back towards machine autonomy, albeit with a nature very different from the 'automatic' systems labelled on Stanley's moral compass.



Interactive specification

The above illustrates a combination of the categories established by Stanley and Cariani, describing a balance of specification between human interactor and computer system. The balance of specification shifts from open interactions on

22. Will Wright and Brian Eno, "Playing with Time," *The Long Now Foundation*, 26 June 2006. http://fora.tv/media/rss/Long_Now_Podcasts/podcast-2006-06-26-wright-and-eno.mp3
23. David Chalmers, "Varieties of Emergence," in *The Re-emergence of Emergence: The Emergentist Hypothesis from Science to Religion*, ed. Philip Clayton and Paul Davies (Oxford and New York: Oxford University Press, 2006).
24. Cariani, "Emergence and Artificial Life."
25. Douglas Bagnall, *A Filmmaking Robot,* 2006. http://halo.gen.nz/robot
26. Peter Cariani, "To Evolve an Ear: Epistemological Implications of Gordon Pask's electromechanical Devices," *Systems Research* 10, no.3 (1993): 19 – 33.
27. Cariani, "Emergence and Artificial Life," 789.

the right side, towards system autonomy on the left.

- *Automatic Systems* that run without interaction or intervention from outside sources. For example, Ingram's *Painting Assemblages*.
- *Reactive Systems* that allow a minimum level of interaction, often defined by low definition input devices and coarse interactive granularity. For example, the branching narrative structures of DVDs.
- *Interactive Systems* that incorporate a fundamental level of interactivity involving a continuous feedback loop of action and reaction. For example, goal-based games.
- *Instruments* with a rich level of interactive granularity and a focus on interactions promoting creativity. For example, Rokeby's V*ery Nervous System*, the author's *Light Tracer.*
- *Platforms:* comprehensive systems to be utilised for further production and creation. For example, *Processing*, Rokeby's *SoftVNS*.
- *Adaptive Computational Systems* with the capability to alter and adapt their computational parts based on their performance in past interactions. For example, Bagnall's *Filmmaking Robot.*
- *Structurally Adaptive Systems* with the capability to change their structure based on their performance in past interactions. For example, Pask's electrochemical ear experiment.
- *Motivationally Autonomous Systems* capable of establishing their own performance-measuring criteria.

These categories are not intended to be either definitive or mutually exclusive. Interactive systems could be classified as, or contain elements pertaining to several categories across the spectrum. Moreover interactivity is highly user specific; while one user may be tentative and reactive, other users may push the same system towards the realm of instruments.

It is hard to steer clear of value-judgements about what the outcomes of interactivity should or should not be. Interactive art has often been self-referential, providing a metacommentary on interactivity itself. Such works can potentially provide useful critiques on the role of technology, however too many fall short and amount to mere 'naïve celebrations' of technology.[28]

While open interactions are by no means new, they evolve a step beyond the so-called transformation of passive observer into active creator. Haque and Pangaro suggest the time is right for adopting more productive interactions because "we are no longer 'naïve' in dealing with our technological interfaces, and therefore we expect more from them and are more able to comprehend the structures behind them." They draw a distinction between *intelligible* and *intelligent* interactivity: "Intelligibility requires predictability and a finite language. Intelligence, on the other hand, requires creativity and the unexpected."[29]

Coming across the unexpected when interacting with computers is almost inevitably perceived negatively as an unintended and unwanted 'bug'. While the promise of systems capable of "amplifying our own creativity" is seductive.[30] However, does such a definitive goal contradict the idea of partnership and reduce the system to a mere tool? Truly conversational interactive systems are inherently open-ended and should thus produce positive *as well as* negative outcomes.

28. Huhtamo, "It Is Interactive—But Is It Art?," paper presented at ACM Siggraph 93, reprinted in *Computer Graphics Visual Proceedings* (New York: ACM Siggraph, 1993), 133.
29. Haque and Pangaro, "Paskian Environments."
30. Cariani, "Emergence and Artificial Life."

5: Douglas Bagnall, *A Filmmaking Robot*, 2004, software, monitors, video cameras, still images from finished films by robot.
"Frustrated by his inability to see film as anything other than changing fields of colour, Bagnall decided a computer would be much better at the task of directing. *A Filmmaking Robot* replaces human aesthetic decisions with a series of algorithms. With help from Stagecoach and CityLink, Bagnall directed cameras on Wellington buses to transmit video footage back to his robot whenever they passed through a wireless hotspot. The robot assigns each frame of this footage a series of numbers based on aspects like brightness, saturation, and detail. Each frame is placed into a matrix based on these values—similar images and scenes cluster together, though imperfectly. Throughout the day, the robot weaves through the space of this numerical matrix, selecting its favourite images based on a broad set of criteria (including its 'training' with Impressionist paintings and its preference for images it hasn't encountered before), compiling them into short clips. The robot's unawareness of location and time and its indifference to whether a frame occurs before or after any other, means the resulting montage is dislocated and dreamlike. Fragments of a monotone rain sequence are shattered by hyper-coloured frames deemed to be better. Cars reverse-park and bus routes are played backwards." (Luke Munn)

fig. 5