Annie Spinster
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Virtual Worlds for Virtual Lives

A Feasibility Study to Determine the Suitability of Three Different Virtual Environments for Creating an A-Life Art Project using a Virtual Ecosystem and Real-World Environmental Data

It is interesting to contemplate a tangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us.

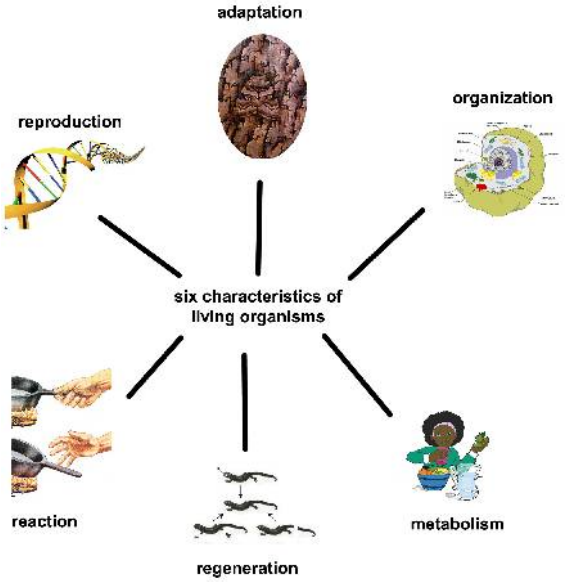
Charles Darwin, On the Origin of Species

Everything is what it is because it got that way.

D'Arcy Thomson, On Growth and Form

What is Life?

Answers to this question vary widely, from religious[1] and secular[2] notions of matter imbued with spirit or some sort of vital essence, through pragmatic check-lists of characteristics of living organisms[3], to attempts to abstract a clear, substrate-independent, rule-based definition.



What is Life?

This latter sort of explanation suggests a way of defining life which could be equally applicable to A-Life models. Steve Grand says that “patterns that persist by metabolising and reproducing are alive”[4] Interestingly, he uses the term metabolism as a loose, non-biological analogy for any process which takes in energy from the environment to sustain itself, such as an autocatalytic network[5].

There is, even within the scientific community, no single definition of what life is. Gerald Joyce and Tracey Lincoln, of Scripps Research Institute, California, have recently created a self-replicating RNA molecule which evolves to reproduce faster. “ I wouldn't call these molecules alive” says Joyce, “to mimic biology, a molecule must gain new functions on the fly, without laboratory tinkering ... It doesn't have open-ended capacity for Darwinian evolution” However, public commentary around this experiment reveals that a lot of people disagree and think that not only are all evolutionarily gained functions ultimately in the service of faster reproduction, but that if the experiment ran for long enough, it might acquire new functions towards just this end.[6]

The cyberneticist Korzeniewski uses a highly abstracted definition of life: “a living individual is defined within the cybernetic paradigm, as a system of inferior negative feedbacks subordinated to (being at service of) a superior positive feedback”[7] What does this mean?

Negative feedbacks are self-regulatory mechanisms. In the words of Grand, “negative feedback tends to counter any change and restabilize the system”[8]. The classic example of negative feedback is a thermostat. It turns on when the room gets too cold and off when the room gets too hot, regulating the temperature within a certain band. Negative feedback in living organisms includes regulation of body heat and metabolic rate and the contraction and expansion of the eye's iris which regulates the amount of light reaching the retina.

The iris: a negative feedback mechanism and population growth: a positive feedback mechanism

Positive feedback is “something which tends to exacerbate a change”[9] . Non-living examples include nuclear reactions and avalanches, where small initial changes trigger increasingly large systemic changes in the same direction. In living systems, positive feedback can be seen in the exponential proliferation of a species until the point where the environment cannot support any further growth, and in the mechanism of natural selection which causes successful genotypes to be propagated through a population at the expense of less successful ones.

What Korzeniewski seems to be saying is that the living individual uses self-regulatory mechanisms (negative feedback) in order to survive and reproduce (positive feedback). Is this really all there is to life?

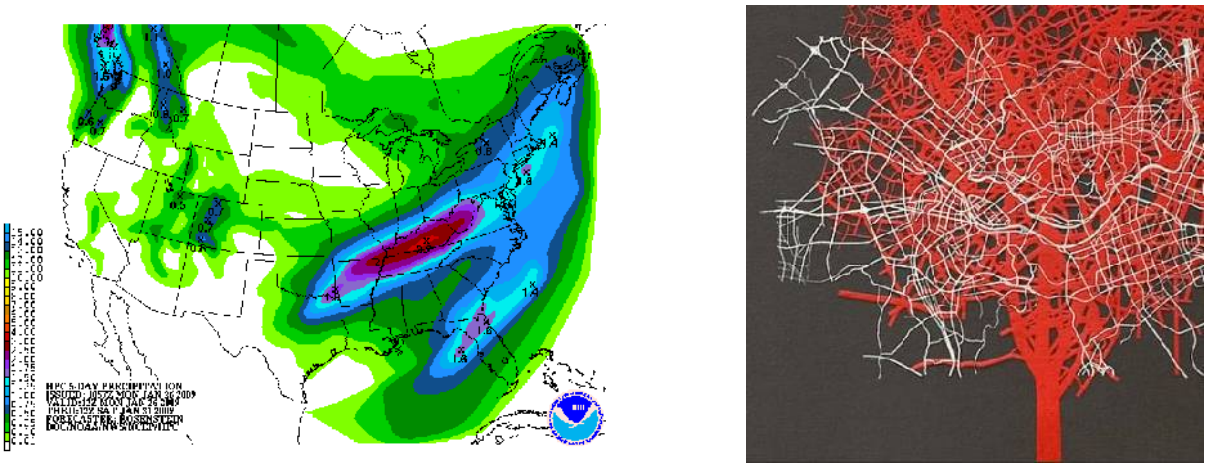
viruses and social insects create problems for definitions of life

The other common scientific way of defining life, using a set of characteristics, is not only conceptually dissatisfying (it describes, rather than defines), but it runs into problems with certain borderline cases such as viruses, which rely on host cells to perform most of these characteristics, and social insects where the different characteristics are shared out among different members of the nest. By careful definition of the “living individual”, for example defining it as the virus+host or the whole insect colony, “the cybernetic definition ... seems to allow for distinguishing in a sharp and unequivocal manner between living entities and inanimate objects”[10]

There is general agreement among scientists that however life is defined, there is no need to invoke vitalist concepts to explain it. As Dawkins says: “There is no reason to think that the laws of physics are violated in living matter. There is nothing supernatural, no 'life force' to rival the fundamental forces of physics. ... The body is a complex thing with many constituent parts, and to understand its behaviour you must apply the laws of physics to its parts, not to the whole. The behaviour of the body as a whole will then emerge as a

consequence of interactions of the parts”[11]

The themes of complexity and emergence are common both to biological scientists and A-Life practitioners, as well as those from a wide range of other disciplines. What do these words mean? Briefly, Complexity theory states that there are certain systems involving large numbers of variables which produce organised results in the absence of any organising principle (no part of the system is 'in charge') because of the way the parts are connected together, and that the way to understand these systems is to approach them from a bottom-up direction: looking at local rules and behaviours of the constituent parts, rather than a top-down approach: starting with the whole system and taking it to pieces to try and determine how it works.[12] Examples of these sorts of complex systems include cities, the weather, economies and living organisms. Emergence is the word used to describe the organised outcomes of these systems and what they all have in common is that they appear to be “more than the sum of their parts”.

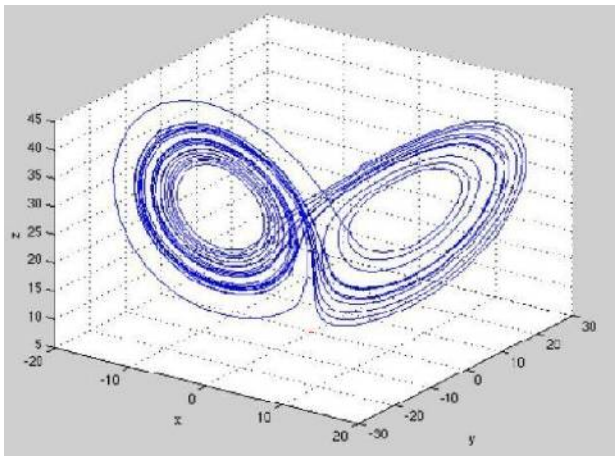


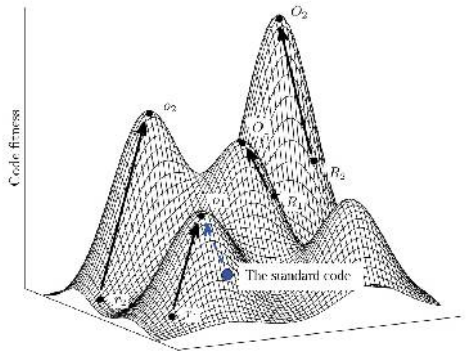
examples of complexity: weather systems and cities

What is tremendously useful in these ideas is that exactly the same principles can apply to all sorts of different situations, on different scales. Thus, A-Life's methodology “relies on bottom-up (not top-down) processing, local (not global) control, simple (not complex) rules and emergent (not preprogrammed) behavior”[13] and an ecosystem is described by DeLanda as “a complex assemblage of a large number of heterogeneous components: diverse reproductive communities of animals, plants and micro-organisms, a geographical site characterized by diverse topographical and geological features, and the ever diverse and changing weather patterns”[14]

“assemblage”, a concept DeLanda has borrowed from Deleuze, refers to a coming-together of a specific set of heterogeneous (i.e. different) physical phenomena to form a functioning whole, without the different parts merging or losing their heterogeneity, for example, “the assemblage which a walking animal forms with a piece of solid ground (which supplies it with a surface to walk) and with a gravitational field (which endows it with a given weight).”[15] Deleuze's ontology, as interpreted by DeLanda[16,17], constitutes a complex and highly abstract materialism. The emphasis is not on things, but on the relationships between things (rhizomes, assemblages) and on potentialities and fluxes (intensities) driving processes of becoming and dissolution (territorialisation, deterritorialisation) via an abstract plane populated by singularities or attractors (multiplicity, plane of consistency). These latter concepts have marked similarities with phase spaces and fitness landscapes – tools for visualising the multidimensional possibilities and probabilities of complex systems. These conceptual tools provide a new way of looking at organisms and ecosystems, not as fixed things or essences, but as

persistent phenomena. In the words of Grand, “To see yourself as a persistent *phenomenon*, when the substrate from which you are made is in constant flux, is to begin to understand life”[18].





phase space and fitness landscape

If I can apply the patterns of connection found within living ecosystems to an entirely different substrate (computer-code defined virtual objects), is what I create a real ecosystem? Grand would say yes: “if we simulate nerve cells using computer code, then they are not really nerve cells. But if we use these simulated nerve cells to build a brain and the brain thinks, it is not the brain's fault that its constituent neurones are a sham; it will still be a brain and its thoughts will still be real thoughts ... We can therefore think in terms of different orders of simulation ... what I am claiming is that second- and higher-order simulations are real things in a way that first-order ones are not, and that these emergent entities are freed from some of the restrictions that apply to first-order ones”[19]

This is a contentious view. As Boden says, “The claim that even virtual creatures in cyberspace could be genuinely alive is called strong A-Life, in analogy to strong AI. Most A-Lifers reject it ... Or rather, most reject the view that such creatures can be alive in just the same sense that biological organisms are, but allow that they are, or could be, alive to a lesser degree”[20]

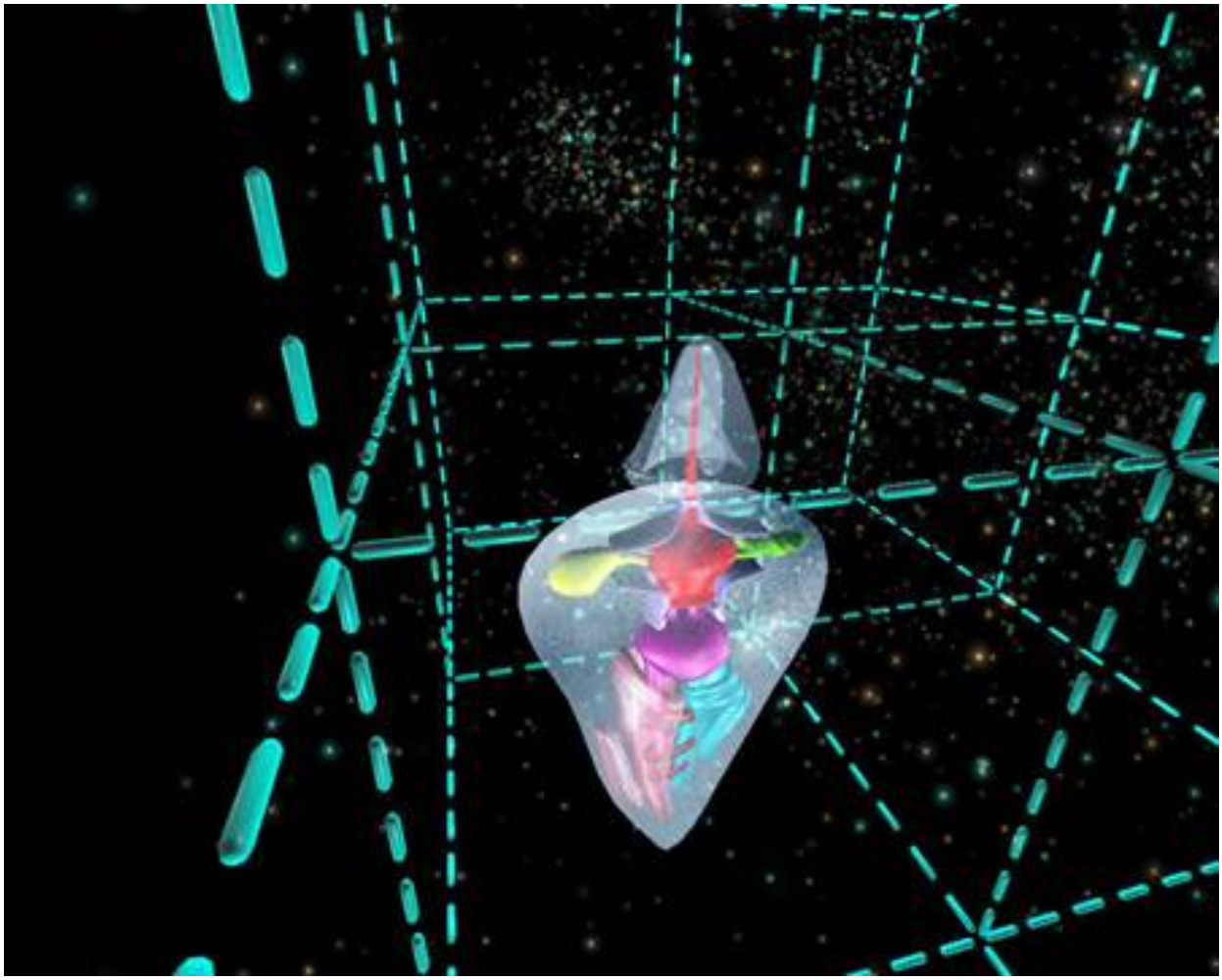
To conclude this part of the discussion, there seems to be no universal agreement about what life is, or whether A-Life can be considered real life. The question of whether something is alive or not does not even boil down to a yes-or-no answer if A-Life can be “alive to a lesser degree”. Fortunately, “these philosophical questions do not need to be definitively answered for A-Life to progress, or be scientifically illuminating.”[21] and what I can take away are a set of useful concepts and ways of working for producing my project.

Choosing A Platform

My main task, then, is to find a virtual environment that will support the creation of a complex system – one with lots of internal and external connections – so that my ecosystem is capable of producing some interesting emergent properties. There are also some other factors I need to take into account, such as the time it will take me to learn how to use the tools, the potential for an online audience and overall costs.

The three virtual environments I investigated are Second Life[22], OpenSimulator[23] and Unreal Tournament 3[24]. More details of this research and the full results can be found in the Appendix to this paper. Here, I will present and discuss the main findings and my conclusions.

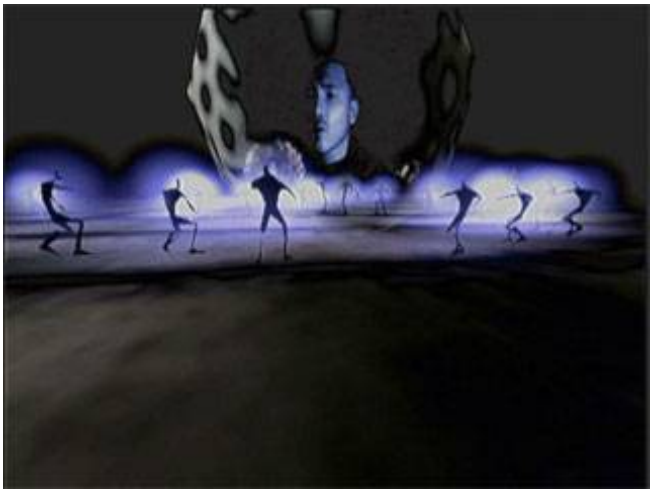
Unreal Tournament 3
Unreal Tournament 3 is a popular first-person-shooter style computer game. The Unreal Engine can be used to create highly detailed virtual environments and interactive objects using UnrealEditor, external 3D modelling programmes such as 3DS Max and UnrealScript – the native scripting language.



Upokrinomena featuring the Diaphaplanomena

Unreal Tournament has been used to create some impressive artworks and A-Life projects such as *Upokrinomena* by Marc Cavazza, Simon Hartley, Louis Bec, François Mourre, Gonzague Defos du Rau, Remy Lalanne, Mikael Le Bras and Jean-Luc Lugrin. The project

features the *Diaphaplanomena:* a self-regulating artificial organism which responds to its environment through a set of internal organs or systems which regulate osmotic flow, metabolism, the pumping of nutrients around the organism's body and the temperature of the organism[25].

Home Dictate by Ivor Diosi

In *Home Dictate*, Ivor Diosi has linked speech recognition software to the Unreal engine. The aim of this “game” is to speak like a politician in order to influence a population of “bots”, whose behaviour changes according to the content of the speech, leaning more towards family and reproduction, exploration and construction or war and carnage[26].



Lilith by Pavel Smetana

In *Lilith (brain in the machine)* by Pavel Smetana, VR hardware and biological sensors dynamically produce an environment in response to the viewer's physical and emotional state. “The visitors experience a journey through only the virtual landscapes into which their own physical and psychical (psychological) mental condition leads them. The virtual landscapes, originating from the 3D engine used in computer games, are projected stereoscopically directly in front of the visitors, who can experience a situation resembling daydreaming in a private 3-D movie house.”[27]

Unreal Tournament is capable of producing highly sophisticated graphics, but it has a number of characteristics which make it unsuitable for producing my ecosystem. It relies on a system of pre-modelled objects, stored in a database, along with pre-recorded animations for moving from one shape to another. Also, it is not designed for creating persistent worlds which endure whether anybody is there or not. These factors would make it difficult to allow creatures to evolve in any meaningful sense. UnrealScript has no built-in functionality for passing data into and out of the game. It would be necessary to obtain a licence and edit the source code to achieve this.[28]

Added to these problems, there doesn't appear to be much potential for attracting an online audience. Those already involved with UT generally want to play it as a first-person-shooter and I have been unable to find any sort of wider arts culture associated with the game. The tools (both UnrealEditor and external modelling programmes) are completely new to me and it would be difficult to produce something “finished” within the time available.

Second Life

Second Life is an online virtual environment used in many different ways by its residents. The main uses are social networking, exploring, roleplaying and content creation. There is a thriving “indigenous” arts scene in Second Life (art made inside Second Life or using SL as a medium), with work ranging from inworld photography and machinima, through kinetic sculpture, often incorporating light and sound, to immersive, interactive installations and performance art events. A few projects have used live data from outside Second Life, notably Andrew Burrell/Nonatus Korhonen's A-Life art project *uncharted pages from a voyage of the beagle* which gives viewers in a real-life Canadian gallery some control over the slowly evolving system in Second Life[29].


uncharted pages from a voyage of the beagle by Andrew Burrell. Gallery image by Jason Thiry

Remote, a mixed-reality art project by Neill Donaldson, Usman Haque, Ai Hasegawa and Georg Tremmel[30], set up a complicated system of sensors between real life and Second Life: “Communication between the two halves of this extended environment is a complex choreography coupling the environmental phenomena of humidity, temperature, light, speech, mist, wind, sound and proximity across the two. ... Visitors to the Boston space and the Second Life space must negotiate to achieve goals: e.g. by sitting down, breathing, touching, knocking, colliding.”[31]

Remote by Neill Donaldson, Usman Haque, Ai Hasegawa and Georg Tremmel

There are also a very few artificial life projects which do not call themselves art, most notably *Svarga*, by Laukosargas Svarog [32]: a whole island ecosystem incorporating weather, plants, insects and birds. "If I was to turn off the clouds the whole system would die in about six hours ... Turn off the bees and [the plants stop] growing, because nothing gets pollinated. And it's the transfer of pollen that signals the plants to drop seeds. The seeds blow in the wind, and if they land on good ground according to different rules for each species, they grow when they receive rain water from the clouds. It's all interdependent."[33]

Svarga by Laukosargas Svarog

Second Life is not very advanced graphically. The building tools are necessarily simple in order for the grid to cope with so much live, user-generated content. It also has a few stability problems – occasional crashes and malfunctions.

However, it has a number of advantages for what I am trying to do: I can change the parameters, and so the appearance and behaviour, of objects in real-time, using the native scripting language (LSL), and, because Second Life is set up as a persistent world (it's still there, running, if everybody logs off), I can allow my ecosystem to evolve over a long period of time. LSL has built in XML support, making it easy to feed data in and out of the project[34]. Other advantages include the well-developed support network for the arts: galleries, event venues and publicity tools and the fact that there is already a large online audience who enjoy the arts in SL[35]. In addition, I have some prior experience of building in Second Life and am making good progress with scripting. Because of this, it will be possible to create a fully functioning ecosystem within the available timescale.

OpenSimulator

OpenSimulator is an open source technology based on Second Life. It enables the user to host an entire island (region), or several, on their own computer, and to connect and share their regions via various grids, such as OSGrid[36] and OpenLife Grid[37]. This is very new technology and is still in alpha development.

The big advantage of using OpenSimulator would be that I could test everything offline and could afford a much bigger area of virtual land. I could connect to a number of different grids to share the work, either as a touring exhibition or simultaneously, allowing different ecosystems on different grids to evolve in different directions.

OpenSimulator has the same set of building and scripting tools as Second Life, except that certain scripting functions are not yet implemented[38]. One big problem for my project is that loops cannot be used, making it difficult to use genetic algorithms as they rely on loops to cycle through each element in the object's “genotype”.

An even bigger problem, however is that I have been unable to find a grid that is stable

enough to rely on for this project: crashes are frequent and most of the time there is a large degree of bugginess, causing unexpected behaviour. I have been unable to stay online long enough to find any art projects made using this platform.

instability on the OSGrid

Conclusions

While the Unreal Games engine would undoubtedly be the best tool for highly detailed, realistic modelling and rendering, it has little else in favour of it for this project. It would be difficult to get any dynamic evolution of creatures and extremely difficult to feed data into and out of the ecosystem. The system would also lack any long-term persistence. If I overcame all these problems, and the massive amount of learning required, it would still be difficult to find an online audience.

OpenSimulator is taking off in exciting ways. If it was stable enough, and if the script looping problem could be overcome, it would be wonderful to “tour” the work around different grids, or allow the ecosystem to evolve in different directions on different grids. It is, however, simply too risky to use for this project.

Second Life, while it has some problems in terms of stability and while it is fairly crude in terms of modelling, fulfils all the criteria needed. I can build a truly dynamic and complex ecosystem using readily accessible outside data and allow it to evolve and produce emergent behaviour over time. I can also make use of the well-developed publicity and arts infrastructure to ensure it attracts a sizeable online audience.

References

Some of the references below are “SLurls” - those that start http://slurl.com/secondlife/ ... These refer to locations in Second Life. You can teleport to these locations by entering the SLurl in your web browser. If you do not have a Second Life account you can create one for free at http://secondlife.com.

1 See for example *Genesis* 1: 20-28, Holy Bible, King James Version

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8 Grand, S: 2001, *ibid*. p122

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10 Korzeniewski, B: 2001, *ibid* p286

11 Dawkins, R: *The Blind Watchmaker* (Penguin, London, 1996) p9

12 Johnson, S: *Emergence* (Penguin, London, 2001) pp46-49

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15 DeLanda, M, 2002, *ibid*, p72

16 DeLanda, M, 2002, *ibid,* especially pp3-9 and pp202-233

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18 Grand, S: 2001, p39

19 Grand, S: 2001, *ibid*. pp92-93

20 Boden, M.A: 2001, *ibid*, p38

21 Boden, M.A: 2001, *ibid*, p37

22 http://secondlife.com/, accessed January 10, 2009

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24 http://www.unrealtournament3.com/, accessed January 10, 2009

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http://ive.scm.tees.ac.uk/data/media/Alife2004_Final.pdf, accessed December 15, 2008

26 Diosi, I: *ID Engines::Home Dictate*, 2003. http://www.umich.edu/~entity/immedia/submissions/uploadedmedia/ivory.Home+Dictate+%255BI%255D.doc, accessed December 15, 2008

27 Smetana, P: *Lilith (brain in the machine),* 2006, http://www.smetana.cz/index.php?lang=en&node=107&catid=107&id=14, accessed December 19, 2008

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30 Neill Donaldson, Usman Haque, Ai Hasegawa, Georg Tremmel: Remote, Huret & Spector Gallery, Emerson College, Boston, USA and Ars Virtua, Second Life, http://slurl.com/secondlife/Seventh%20Eye/26/101/47, February 7 – April 15, 2008

31 http://www.haque.co.uk/remote.php, accessed December 21, 2008

32 Laukosargas Svarog: *Svarga*, http://slurl.com/secondlife/svarga/199/127/21/, 2004 (ongoing)

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36 http://osgrid.org/, accessed December 20, 2008

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Appendix: A comparison of three virtual environments: Results

A qualitative study comparing Unreal Tournament 3, Second Life and OpenSimulator. For each virtual environment, I looked at a range of factors affecting their suitability for making my project. Methods included primary, practice-based research, web research and exploring inworld. For the sake of brevity, I have not repeated references here which are already in the main document.

	Unreal Tournament 3	Second Life	OpenSimulator	how important is this factor?
Modelling Potential				
Scripting Potential				
Connectivity				
Cost				
Learning Time				
Precedents				
Online audience potential				
Other advantages and disadvantages				

Notes:

Modelling potential: quality of 3D graphics and texturing detail
Scripting potential: how suitable is the scripting language for creating a complex, evolving system?
Connectivity: How easy is it to send data in and out of the environment fromm elsewhere on the web?
Cost: which environment represents best value for money?
Learning time: Which will be the quickest to learn?
Precedents: How many examples of quality artworks can I find that use the environment?
Online audience potential: How easy will it be to attract an online audience?
Other advantages and disadvantages: points added for advantages and subtracted for disadvantages.

Unreal Tournament 3

- Excellent graphical detail: objects are modelled and textured in external programmes such as 3DS Max. No sky, sea or land – need to model everything from scratch
- UnrealScript is Java-based and Object orientated. Can't change many object parameters using scripts – need to pre-model everything.
- No native XML support
- Server space costs approximately $32-$64/month for 32 slots (players)
  http://www.gameservers.com/game_servers/unreal_tournament_3.php
  http://www.umgleague.com/rent-a-gaming-server.html
  http://gameservers.multiplay.co.uk/order/game-server/unreal-tournament-3/
- Very steep learning curve – lots of new, complicated tools
- Some excellent standalone applications. No networked examples
- Unable to find any online arts community associated with the game
- not a persistent world

Second Life

- Graphics and texturing are basic. Building is done live, inworld. Good sky and water, editable land.
- Linden Scripting Language is Java-based and object orientated. Easy to change object parameters using scripts
- Built in XML support
- Server space costs approx $15/month for 2048 sqm of virtual land (plus initial purchase of approx $30). This is the minimum space I would need. Possible land sponsorship opportunities (http://secondlife.com/land/pricing.php)
- Prior familiarity with building tools. Simple and quick to learn
- Very wide range of arts projects, some A-Life projects
- Large, active online arts community
- A persistent world which will continue evolving when nobody is there
- Occasional stability issues

OpenSimulator

- Graphics and texturing are basic. Building is done live, inworld. Good sky and water, editable land.
- Linden Scripting Language is Java-based and object orientated. Easy to change object parameters using scripts. Can't use loops
- Built in XML support
- Region hosting on own server – very cheap for lots of land
- Prior familiarity with building tools. Simple and quick to learn
- online grids too unstable to research arts projects and community
- A persistent world which will continue evolving when nobody is there
- Constant stability issues