SL-Bots: Automated and Autonomous Performance Art in Second Life

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Abstract

This chapter explores the history, state-of-the art, and interactive aesthetic potential of "SL-Bots". SL-Bots are avatars (i.e. "agents") that are designed and controlled using Artificial Intelligence (AI) in Second Life. Many of these SL-Bots were originally created in Second Life for purposes such as: rudimentary chat [Selavy Oh ca. 2010], inventory management and copying (Burden 2009), asset curation (Galanis, Karakatsiotis, Lampouras, & Androutsopoulos, 2009), embodied customer service, generic responsive environments [Selavy Oh ca. 2010, Mosmax Hax ca. 2008, Adam Nash ca. 2007], scripted objects [Gazira Babeli ca. 2007], or as proxy-audience members (aka "campers"). However, virtual performance and installation artists – including two of the chapter's authors [ca. 2011-present] - have created their own SL-Bots for aesthetic purposes. This chapter suggests ways in which SL-Bots are gradually being extended beyond their conventional applications as avatar-placeholders. In the future, SL-Bots – or an equivalent in another virtual world – might one day transcend their teleological aesthetic purpose from automated-objects towards being perceived as autonomous aesthetic personas.

Overview

We will begin this book chapter by defining bots in the larger context of artificial agent research, and then specifically in the context of the virtual world Second Life as SL-Bots. We will situate SL-Bots in the context of Second Life's corporate and artistic history. This includes an explanation of the finite-state affordances of Second Life's proprietary programming language, Linden Scripting Language (LSL). Then, we will briefly distinguish between automation and autonomy. In brief, automation involves the direct execution of programmed commands and occasionally, supervision while autonomy implies unsupervised and self-directed/self-generated behavior. Then, we situate automation and autonomy within the context of SL-Bots. This history and conventional application of early SL-Bots will be analyzed through the utilitarian lens of automation and also the recent genre of "code performance". Mid-way through the chapter, we will summarize early artistic experiments in Second Life with SL-Bots. These experiments include implementations for automated story-telling and theatrical performance [ca. 2006-2008] (Unterman & Turner, 2014). Further, this history will acknowledge Gazira Babeli's treatment of SL-Bots as scripted objects [ca. 2006], Adam Nash's intelligent responsive environments [ca. 2007-2008] and Alan Sondheim's usage of a large number of customized SL-Bot swarms for environmental impact [ca. 2007-present]. We will also show examples of those state-of-the-art SL-Bots used for artistic purposes[1] that were designed with some level of "autonomy", however rudimentary. Then, we will mention the state-of-the-art of SL-Bots outside of an explicitly artistic domain. To conclude, we will speculate on future implementations of autonomous SL-Bots based on a consideration of historical examples and the current state-of-the-art. The primary purpose of this chapter is to contextualize the perceived evolution from contemporary automated SL-Bots using more narrow Artificial Intelligence (AI) systems towards the next-generation of autonomous bots that employ a broader and less specialized Artificial General Intelligence (AGI).

[1] Ascott et al 2012, Stelarc 2012, Ellsmere/Mounsey 2012, Turner/Nixon 2011, Glasauer 2010, Ayiter/Glasauer/Moswitzer 2010, and Moswitzer 2009. All citations here refer to exhibitions and/or production dates, not academic publications.

Bots In The Artificial Intelligence (AI, AGI) Context

Artificial agents have been defined as computer systems capable of flexible autonomous action in some environment in order to meet their design objectives (Wooldridge, 2009). Their properties include the following (Wooldridge & Jennings, 1995a):

Autonomy: agents operate without direct intervention,

Social ability: agents interact with other agents (and possibly humans),

Reactivity: agents perceive their environment and respond,

Pro-activeness: agents follow goal-directed behaviour.

While this "weak" definition of agency can apply to a variety of low-level system tools, agents are more usefully understood with a stronger definition that refers to systems that are conceptualized and implemented using anthropomorphic terms. Typically, this involves designing an agent around human mental notions such as knowledge, belief, intentions, obligations, and even emotions (Wooldridge & Jennings, 1995a). There is a spectrum of approaches to control structures for such agents, from reactive to cognitive strategies. These control systems provide the appropriate degree of reasoning required for the agent to perform tasks in a given environment. Agents that are intended for social and narrative contexts take on whole new kinds of behaviour-related "tasks" to perform as an actor in those scenarios.

The most straightforward kind of system responds directly to sensed stimuli with an action, and is therefore called a reactive system. The most popular example of reactivity is the so-called subsumption approach. Brooks designed this approach, originally for autonomous mobile robots, based on the principle of embodiment and the importance of embodiment in the development of artificial intelligence (Brooks, 1991). A recent example of this approach is that of Isla et al. who propose a layered model for an artificial brain, where different layers communicate via a shared blackboard, allowing high-level functions to control lower ones (Isla, Burke, Downie, & Blumberg, 2001). Once percepts extract meaning from sensors, the agent's action selection mechanism is based on a function that looks for the highest expected reward among the possible actions. Another reactive approach uses Finite State Machines to control the behaviour of a conversational agent by taking into account the user's perceived emotion along with the mental state of the agent (Egges, Kshirsagar, & Magnenat-Thalmann, 2004). To make the agent less predictable, probabilistic effects can be used in the decision-making process (Chittaro & Serra, 2004). These approaches are straightforward in nature, although they are correspondingly reductive. As we will see, agents in Second Life necessarily follow the Finite State Machine approach.

On the other end of the spectrum are systems that model human cognition in order to take advantage of – or at least portray – the kinds of deliberation we perform before acting. One of the most popular of these models is the Belief, Desires, & Intentions (BDI) model (Rao & Georgeff, 1997) that incorporates some of the practical constraints of being human. Another cognitive approach uses Dynamic Belief Networks to model the human mind and thereby enable a conversational agent (Rosis, Pelachaud, Poggi, Carofiglio, & Carolis, 2003). Agent architectures in this style have focused on the importance of simulating the effects of human characteristics e.g. emotions on the cognitive and decision-making processes of the agent.

Modeling agents after humans provides a useful high-level abstraction for systems that involve human engagement and interaction. In these cases, it is often desirable to render agents visually as a human character. Intelligent virtual agents (IVAs), also called virtual humans, are particular types of artificial agents embodied with a graphical front-end or even a physical robotic body, although the latter are outside of the scope of this chapter. These have been proven useful as a way to progress towards more natural human-computer interactions (Preece et al., 1994). Virtual humans are employed in interactive applications using 3D virtual environments, including simulations and digital games. To be convincing, the motion of

such virtual humans should look realistic (or 'natural') and allow for interaction with the surroundings and other (virtual) humans. In this context, Badler (Badler, 1997) distinguishes between an agent (a virtual human controlled computationally through an algorithmic process) and an avatar (a virtual human under the control of a live participant). It is worth noting for clarity that while some other definitions refer to a virtual body as an avatar regardless of whether it is under human control, we will adhere to Badler's clear convention.

More specifically, we now turn to virtual worlds, which are simulations that often have overt entertainment purposes. Virtual worlds such as *Second Life* (ca. 2003), *There.com* (ca. 2001), *Active Worlds* (ca. 1995), *Traveler* (ca. 2001), and *Habbo Hotel* (ca. 2000) provide users with customizable avatars in graphical environments with a range of communicative affordances including text and voice chat. These avatars will sometimes be given automated features to support the human inhabiting them, such as expressive body language or surrealistic clothing (as we will explore later in this chapter). However, these worlds must also be populated, and that is where artificial agents come in, albeit typically with fairly limited capabilities. In virtual worlds, these are often called "bots" - an etymological derivation of "robot"[2]. Bots refer to a software entity with its own automated or autonomous agency and with the capacity to act independently from a human being, following Badler's categorization.

Bots are semantically different from automated environmental processes and animated-objects. In contrast to automated "natural" phenomena, bots are often anthropomorphized as characters with personality (Leonard, 1997, p. 71). Prior to the modern definition of "bots" explicitly representing disembodied or avatar-embodied "software-robots"; bots have implicitly existed under different aliases throughout history. During times of antiquity[3] and also during the 19th century[4], for example, entities acting independently of human agency were originally referred to as supernatural "daemons" (Leonard, 1997, pp. 15–21, 88–89, 123). Supernatural semantic associations with such agents as intermediaries between worlds continues through the eons into the hyper-rational history of Artificial Intelligence[5] (Leonard, 1997, pp. 18–21). A darker version of this phenomenon can be seen in the history of hoaxes and scams, such as *"The Mechanical Turk"* (von Kempelen, 1769).

By 1950, the suggestion of a Turing Test[6] set the first benchmark for assessing human-level believability in an artificially intelligent agent. To pass the Turing Test, the agent had to convince –through a networked text-chat terminal - to more than 30% of human judges that was "human".[7] On mainframe terminals, early text-based chatterbots such as the simulated Rogerian psychotherapist, *"Eliza"* (Weizenbaum, 1964-66) already began to challenge the ontological boundaries of humanness by blurring the semantic distinctions between "automation" and "autonomy". Culminating with the commercialization

[2] *"Rosumovi Univerzální Roboti (Rossum's Universal Robots)"* - Karel Čapek 1921

[3] e.g. Socrates' "daemon" trial [399 B.C.]

[4] e.g. Maxwell's hypothetical "demon" [1867].

[5] Selfridge, 1958, Corbato, 1963.

[6] Turing, A (1950), *"Computing Machinery and Intelligence,"* Mind LIX (236): 433–460, doi:10.1093/mind/LIX.236.433

[7] Controversially in 2014, one chatterbot named *"Eugene Goostman"* (Veselov, Demchenko, Ulasen, 2001) technically passed a Turning Competition with 33% of human judges believing it to be human. However, otherwise optimistic advocates from the AGI community (i.e. Goetzel 2014, Kurzweil 2014) stated that Goostman only passed this test by relying on its pre-programmed "flaws" and human-communication "shortcomings" such as using English as a second language and claiming to be only 13 years old.

and eventual domestication of the (home)-computer; ludically-driven[8] "gamebots"[9] or "mobiles" [mobs] (Bartle, 2003) also pervaded the social virtual space of solitary and networked human-users via text and/or graphical based Multi User Domains (MUDs/MOOs) as well as video-games (Leonard, 1997, pp. 29–58, 61–84). There, bots provided humans with automated adversaries. As the internet matured, web-based bots took additional roles such as: search-engine spiders (meta-crawlers), cartoon personalities, viruses, pets and office assistants known as Microsoft Agents[10] (Leonard, 1997, pp. 6, 74, 78–84, 103–188). Today, bots also act as NPCs (Non-Player Characters) in video games including MMOGs (Massively Multi-Player Online Games) (Isbister, 2006).

What is *Second Life*?

"Your World. Your Imagination" – Second Life's Corporate Slogan.

Still in existence as of 2014, Second Life remains the most popular non-ludic[11] graphical social virtual world for adults (Fominykh & Prasolova-Førland, 2011, p. 1559), produced by Linden Labs and founded by Philip Rosedale. Second Life is an open "desktop VR"[12] world in that its: environment, virtual inhabitants, scripted automation, graphical poses & animations, and character accessories are entirely user-generated and user-organized. Second Life has a proportionally high artist demographic[13] due to the world's openness and emphasis on user-created content. As early as 2006, for example, users had already spent a total of sixty thousand hours creating content in Second Life (Ondrejka, 2008, p. 238). By 2007, artists, academics, philosophers, scientists and art-critics representing all online countries, ethnicities and genders rose to prominence during Second Life's peak marketing period[14] (Quaranta, 2007). To date, most of the artists in Second Life exhibit representations of conventional art-gallery shows and art-works. Some Second Life artists have turned to avatar-performance art[15] and have used scripted objects as automated performance props. However, only a minority have created art-bots within Second Life.

What are SL-Bots?

In contrast to avatars in Second Life that are controlled remotely by humans using access software called "viewers", SL-Bots employ varying degrees of artificial intelligence to control and mediate their virtual bodies without direct human intervention. Prior to their aesthetic utilization by artists, the majority of SL-Bots were originally created by Linden Labs for: rudimentary chat (Burden, 2009), inventory management and copying (e.g. the notorious CopyBot), asset curation, guided tours (Galanis et al., 2009), and embodied customer service. Some SL-Bots also acted as scripted objects (e.g. animated virtual debris,

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[8] Ludology is the study and theory of game-playing, rather than story-experiencing (Huizinga 1951, Salen and Zimmerman 2004 etc.). Non-ludic worlds allow the agents to act as social and/or ornamental characters in the service of a story-world setting. Such agents would not possess any explicitly game-oriented purpose or goals. An open-ended chat-based world that possesses no explicit rules or points as a pre-requisite for playing such as Second Life can be considered "non-ludic".

[9] An early example is the *"Wumpus"* (Yob 1972-73).

[10] e.g. *"Clippy"* (Atteberry, 1997-2003).

[11] Massively Online Multiplayer Role-Playing Games such as *"World of Warcraft"* (Blizzard Entertainment, 2004) traditionally have held a much higher networked user population.

[12] Desktop VR differs from the fully immersive virtual reality (VR) installations that were developed in earnest from the 1960s to roughly the mid-1990s (Krueger, 1969; Lanier, 1982 etc.). However, the recent inclusion of the Oculus Rift Head-Mounted Display has made immersive VR commercially available to desktop VR platforms such as Second Life.

[13] e.g. Corbett, S. (2009). *"Portrait of an Artist as an Avatar"*. New York Times Sunday Magazine. Accessed online May 23, 2014 - http://vhil.stanford.edu/news/2009/nyt-portrait.pdf

[14] For Italian readers, see: Gerosa, M. (2007). Second life (Vol. 56). Meltemi Editore srl.

[15] E.g. Zero-G SkyDancers (2006-present) - http://zerogskydancers.com – Accessed online May 23, 2014
Second Front (2006-present) – http://slfront.blogspot.com – http://secondfront.org – Accessed online May 23, 2014.

particles, touch activated appliances). Mainstream usage of personified SL-Bots involved populating social spaces as proxy-audience members (aka "campers"). Second Life is still seen as an ideal venue for testing AI concepts (Ranathunga, Cranefield, & Purvis, 2012, p. 4), multi-agent systems, and even simulations of robot experiments as it is "more sophisticated than conventional 2D simulation tools, and is more convenient than cumbersome robots" (Ranathunga et al., 2012, p. 1). Installation and performance artists - including two of the chapter's authors [ca. 2011-present] - have created their own SL-Bots for aesthetic purposes. For example, some scripted objects were used as automated props for performance-art interventions [Gazira Babeli ca. 2007] and responsive ambient environments that catered to the unique personality profiles of avatar visitors [Selavy Oh ca. 2010, Mosmax Hax ca. 2008, Adam Nash ca. 2007 etc.]. Helpfully, avatars can be identified via a UUID (Universally Unique Identifier, see http://wiki.secondlife.com/wiki/UUID) and then used in scripting.

What is LSL?

To encourage user-generated content creation, Second Life also has its own proprietary scripting language to enable automated interactions. This language is known as the "Linden Scripting Language" (LSL) (Weber, Rufer-Bach, & Platel, 2007; Winters, 2008) and documented online (http://wiki.secondlife.com/wiki/LSL_Portal). LSL adds functionality to objects by allowing scripts to be directly embedded into atomic geometrical primitives ("prims"). Like any programming language, there is a learning curve for non-programmers. However, the population of Second Life has risen to the challenge in order to manipulate their environment. By 2008, an average of 15 percent of Second Life's residents reported experimenting with scripting "[…] every week" (Ondrejka, 2008, p. 239).

LSL is an event-driven "finite-state" programming language similar in vocabulary to Java or C. Fundamentally, scripts are on standby and their instructions are only executed when a discrete sensory event occurs in Second Life. Common examples of Second Life "events" include: an avatar's virtual touch, proximity, or specified text-chat commands. Integral to the event system is LSL's sensor function, which is also limited as a sensor can only detect "16 avatars and/or objects in one sensor function" at a time-step (Ranathunga et al., 2012, p. 5). Also, the "[…] maximum sensor range is 96 [virtual] metres" (Ranathunga et al., 2012, p. 5). The use of multiple sensors only compounds this problem as it consumes bandwidth and other computing resources, and causes the SL-Bot to experience performance "lag" (Ranathunga et al., 2012, p. 5). Despite the ability to include Boolean operations (Weber et al., 2007, p. 37) as well as looping control operations, the event-driven nature of scripted items in Second Life means that they are typically simple as they cannot easily deliberate while idle. Alternatives to LSL such as LIBSecondLife[16] or LIBOMV[17] might allow for autonomous logical deliberation, more robust sensor-parsing capabilities and expedient performance speeds but are dependent on a persistent and deterministic placement of additional objects for dynamic position updating (Ranathunga et al., 2012, p. 5; Weitnauer, Thomas, Rabe, & Kopp, 2008, p. 5). Because of the finite-state design of LSL, as well as latency-based environmental limitations within Second Life, SL-bots are usually perceived as "automated" robots or scripted objects rather than as fully autonomous entities.

About The Automated Nature Of SL-Bots

Many established AI designers and Second Life artists have stated their own expert advice – based on their respective discipline - on matters regarding their subjective perceptions of agent automation compared with autonomy. These expert opinions are gradually making ambitious next-generation virtual agents become a tractable reality. The functionality of such agents over time, will be objectively assessed

[16] An open source networking protocol - http://secondlife.wikia.com/wiki/Libsecondlife - Accessed online June 04, 2014.

[17] Libopenmetaverse. - http://lib.openmetaverse.org/wiki/Main_Page - Accessed online June 04, 2014.

directly through next-generation implementations, empirical observational and/or literary (e.g. code) analysis, behavioural tests and user-studies.

The Second Life artist Alan Sondheim feels confident in his subjective assessment of the semantic distinction between automatic and autonomous agents in Second Life. Of his own performances Sondheim says that he, "didn't have bots but had robotic followers of whatever was going on" (Personal communication with Jeremy O. Turner, March 15, 2014). For Sondheim, his followers were "[…] not independent" of the human-avatar controller and he explicitly saw all of his SL-bots as "automated" (Ibid.). With Sondheim's *"Julu Twine"* (2009) *[shown in* Figure 2~~*Figure 2*~~*]* SL-Bot in particular, he felt that although its visual avatar design was diverse and could blend in with its architectural surroundings or function as a discrete figural presence; its actual interactions with other entities seemed "stiff and dying, […] as if nothing was alive but a control-system" (Ibid.). Without possessing true autonomy, these automated SL-Bots – and similar agents such as NPCs in video games – have been criticized for acting as puppet-automatons by being "cognitively empty" (Bringsjord et al., 2008, p. 89). Avatars and Agents (bots) alike are "spotted in digital environments as mere shells" representing genuine agency, emotion and intellect (Bringsjord et al., 2008, p. 89). However, these "mindless shells" can at least sometimes persuade an interacting human that they possess a convincing simulation of autonomy, if only due to visual similarity. Otherwise, there is no strong cognitive indication that these bots might one day become genuinely human-like or at the very least, be contemplated as discrete beings with their own sense of teleological agency and autonomy.

Scripted Objects: The Personified Illusion Of Autonomy

The creation of scripted objects led to a new genre of automated performance art in Second Life called "Code Performance". Code Performances "[…] use code rather than avatar action as the expressive form of the work. […]" and have been known to "on occasion, challenge the agency of other avatars within the virtual space" (Unterman & Turner, 2014, p. 214). With some occasions, the environment itself would be scripted and take over the unwitting avatar "participants" by forcing them to "dance, emit particles, etc." (Unterman & Turner, 2014, p. 214), as well as altering their avatar's visual appearance. In other instances, such as Adam Nash's scripted responsive environments, [18] objects collaborate with the avatar explorer to create harmonious aesthetic interactions. The most bot-like of these scripted objects for code performance was a tornado-bot designed by the Italian avatar performance artist, Gazira Babeli.[19] *"Don't Say"* (2009)[20] is an automated semi-anthropomorphic scripted tornado that provides the illusion of acting as a personified force-of-nature suggestive of autonomy *[shown in* Figure 1~~*Figure 1*~~*]*. When touched by an avatar, the tornado will persistently stalk and rattle that avatar until he/she apologizes for both touching the tornado and for every recorded text-string the avatar utters in the public chat-log.[21] This aggressive persistent willpower combined with the tornado's personified ability to provide chatterbot-style text-chat responses, compels the human interactor to create more conceivable interactive states in his/her imagination about the relative autonomy of this tornado-bot than actually exist within Second Life's finite-state architecture. While creating a larger world of possibilities is a powerful effect, Crawford's perspective on interactive systems is that "one way to judge the interactive quality of a design is to examine the ratio of accessible

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[18] SL name is "Adam Ramona".
See "*Seventeen Unsung Songs"* (Nash 2007). Review by Lisa Dethridge.
http://yamanakanash.net/secondlife/unsung_songs.html
"A Prim's Happiness" (Nash 2010). Machinima video by Iono Allen. http://vimeo.com/7553622
Web content accessed online May 29, 2014.

[19] SL name. See the catalogue - Quaranta, D. [Ed.] (2008). Gazira Babeli. Brescia, Italy: Fabio Paris Editions. 88 pages. ISBN: 978-88-903308-3-4.

[20] http://www.gazirababeli.com/dontsay.php Visit this webpage to view screenshots, a video and a sample of the LSL code. See also *"Gaza Stripped"* (2007) - an interview with Gazira Babeli by Wirxli Flimflam (Jeremy O. Turner) http://www.gazirababeli.com/TEXTS.php?t=gazastripped – Both websites accessed online May 28, 2014.

[21] http://turbulence.org/blog/archives/003987.html - Accessed online May 29, 2014.

states to conceivable states (Crawford, 2003).” Ultimately, participants can become frustrated if easily conceivable states end up being inaccessible.

In mod-culture[22], there is a consensus impression that most bots have similar characteristics to Gazira’s tornado. There are many examples where scripted-entities seem to have an agency of their own, are out of our control, and seem alive as "pests". In the early days of mod-culture, these persistent pests[23] were tolerated by moderators as embodied icons of a wild and lawless frontier mentality of cyberspace (Leonard, 1997, p. 92). Leonard provides plenty of evidence from text-based virtual communities to suggest that such bots are perceived by community members as inherently autonomous (Damer et al., 1997). This perceived ludic autonomy was initially at odds with this community's social norms within cyberspace – especially within video game communities (Morningstar & Farmer, 1991). Despite the initial ludic frustration caused by interaction with these “pests”, the virtual community inadvertently fundamentally re-writes the interaction norms through their ludic and/or behaviour that eluded the ludological constraints[24] set by the community designers (Leonard, 1997, p. 13).

Figure 1: A tornado-bot forces Gazira Babeli to apologize in “Don’t Say” (© 2006, Gazira Babeli. Used with permission.)

About Autonomy

[22] Modification (Mod) culture is not to be confused with Modernism or the sub-culture in 1960s England. Mod culture is where creators modify video-game-templates to create artistic statements. See Leonard, 1997,

[23] e.g. the Barney-bot and Cthulu-bot examples in Point MOOT. (Leonard, 1997, pp. 3–8)

[24] Taylor, T. L. (2003). Intentional bodies: Virtual environments and the designers who shape them. *International Journal of Engineering Education, 19(1)*, 25-34.

Unlike the illusory impressions of autonomy evoked by some SL artists, actual autonomy has been defined where "learning occurs both automatically, through exposure to sense data (unsupervised)" and must possess "bi-directional interaction with the environment, including exploration and [self-supervised] experimentation" (Voss, 2007, p. 132). This type of intelligent interaction would give these SL-Bots a semblance of teleological agency and situate them closer to the ideals of Strong-AI or Artificial General Intelligence (AGI). To meet the baseline for genuine human-level autonomy, a SL-Bot would at the very least need to be able to communicate through a language, have the capacity to reason about the world, and have some representation of will-power (Bringsjord et al., 2008, p. 31). The "will" is defined loosely as the ability to independently "make choices and decisions, set plans and projects" (Ibid.) with an intentional force towards action in a stochastic (non-deterministic) environment. Ideally, an SL-bot would need a human-like capacity for both 'consciousness' ("for experiencing pain and sorrow and happiness, and a thousand other emotions – love, passion, gratitude" (Bringsjord et al., 2008, p. 31)) and 'self-consciousness' ("for being aware of his/her states of mind, inclinations, preferences, etc., and for grasping the concept of him/herself" (Bringsjord et al., 2008, p. 31)) as well as a unique set of desires (towards objects, characters and the self), beliefs, intentions and goals. These base-line standards for autonomy in virtual worlds have been confirmed as the capabilities to perceive, act and reason, along with social skills (Weitnauer et al., 2008, p. 2).

Figure 2: Various screenshots of "Julu Twine" in Second Life. (© 2009, Alan Sondheim. Used with permission.)

We will now explore examples of automated processes before discussing examples of SL-Bots with some detectable level of autonomy. Some bot-artists have re-purposed proprietary software created by

scripters in the community as the "AI" (in contrast to "AGI") interface for automated performance art. For example, "Jo Ellsmere" (her Second Life moniker) and various collaborators have customized bot-animation sequences using an automated avatar-choreography ("dance machine") program called *"DanceMaster Pro"* (aka "DM Pro").[25] DM Pro can accommodate controlling the animation sequences of up to 36 automated "dancers". Ellsmere finds DM Pro to be a very robust and scalable tool for automated animation-sequences of virtual bodies. In fact, Ellsmere has technically designed her bot-performances around her gradual fluency with DM Pro's pre-designed interface, system affordances and proprietary programming sub-language, PCL. "Performance Control Language" is a proprietary sub-language created by Brynden Burton (SL avatar name), which sits on top of the code-base of LSL. It allows less code-literate choreographers to design interactive functionality. Catering to either discrete run-time and/or continuous real-time interaction scenarios, DM Pro gives the bot animation designer a finite amount of simultaneous bot formations[26] but otherwise, many choreographed options. These options can either be executed automatically without human supervision and/or improvised via the human-controlled avatar's step-wise manual control and supervision of the SL-Bot. For example, bot-designers in DM Pro can dynamically "[…] create and assign […] animation patterns to […] formation positions"; and "[…] create complete automated animation performances with timed and choreographed changes to animations, formations, music, and particle effects" ("Pro," n.d.). Further, an SL Bot's automated performance-animation sequence can make a bot's virtual objects/props/accessories appear on command and also utilize event-based idling sequences by having finite-state animation loops that "contain repeating sections, [and] timed waits" ("Pro," n.d.). DM Pro also goes beyond Second Life's generic chatter-bot functionality through the capability to automate the movement-synchronized presentation of text-chat string narrations ("Pro," n.d.).

[25] Developed by Bryndyn Burton (SL name). http://bryndynburton.wordpress.com/dancemaster/pro/ - Accessed online May 27, 2014. According to email correspondence, Burton considers DM Pro to be an "animation control system" and not an "AI-system". This might mean that he does not consider DM Pro to be an AGI system – Accessed June 06, 2014.

[26] "There are limits to the number of 'formations' that can be on any given internal notecard. It is possible, though, to use multiple formations notecards for a performance." (Jo Ellsmere, email interview with Jeremy O. Turner, April 29, 2014).

Figure 3: This screenshot shows the automated merging of 3 bot-bodies in "The Mask: a synchronicity" (© 2011, Ellsmere. Used with permission.)

"The Mask: a synchronicity" (Ellsmere, 2011)[27] and *"ANIMAanimus"* (Ellsmere, 2012)[28] represents Ellsmere's first experiments with the automated choreography capabilities of DM Pro. These performances automate DM Pro sequence routines that showcase the visual merging of texture-mapped and texture-less bot-bodies *[shown in* Figure 3~~*Figure 3*~~*]* with gender-ambiguous animations.[29] These bot-bodies seamlessly merge through each other due to an option in Second Life's physics engine to remove the collision detection that distinguishes between different virtual bodies. However, these SL-Bots are not at all interacting with the audience members. For Ellsmere, "there is the *appearance* of interaction, but that's

[27] A collaboration with Pyewacket Kazyanenko (SL name) and Kai Steamer (SL name) to illustrate Carmen Auletta's (SL name) poem *"A Maschera"* for Museo del Metaverso's "Art and Poetry" series in Second Life, September 2011.
https://vimeo.com/41673225 - Accessed online May 27, 2014.

[28] *Systems of Existence"* (October 2012) exhibition. Extropia Core, Extropia Island, Second Life. Aesthetic consultation provided by Philos Kidd (SL name).
https://www.youtube.com/watch?v=DnlNed4EY8g&feature=youtu.be – Accessed online May 27, 2014.

[29] Ellsmere and Kazyanenko explore the Jungian archetypal limitations of gender identity and are inspired by the extreme gender stereotyping of typical male-/female-specific animations available within Second Life. [Paraphrased from an email correspondence with Jeremy O. Turner. April 29, 2014].
"Mask [...]" features 3 animated SL-Bots while *"ANIMAanimus"* showcases 6 texture-less but mono-chromed bots of different colors.

all" as it is "[…] up to the choreographer to time things and choose animations that work well and smoothly together" (Personal communication with Jeremy O. Turner, April 29, 2014). In other words, Ellsmere and many other SL-bot-designers are not as concerned with the AI-functionality of the SL-Bots behind the scenes as they are with composing synchronized animation sequences and finite state-transitions with precision. Instead, they are more concerned at this historical stage with automating and conserving their authorial expression into a coded performance document (i.e. scripted "notecard") much in the way music composers and theatre directors have done prior to the authorless innovations of "indeterminacy" pioneered by John Cage (Cage, 1961).

Ellsmere has also created collaborative bot-works that utilize DM Pro's PCL language. For example, *"Homage to Meyerhold"*[30] (Ellsmere 2014) and *"Legs on Coppelia"* (Ellsmere/Kazyanenko 2013)[31] *[shown in* Figure 4~~*Figure 4*~~*]* retrieved their scripted animations via what are known as multi-animation "poseballs".[32] In the latter performance, the leg-bots would have their animations synchronized to in-world streaming media such as videos and virtual shadow effects. This direct human/avatar authorial control over SL-Bots is most apparent in the dyadic bot-performance, *"Pardon our Zeitgeist"* (Ellsmere/Kazyanenko 2012) *[shown in* Figure 5~~*Figure 5*~~*]*.

Figure 4: "Legs on Coppelia" (© 2013, Ellsmere & Kazyanenko. Used with permission.)

[30] Part of the Peter Greenaway/Saskie *Boddeke The Golden Age of Russian Avant-garde*" project, exhibited live in Moscow, Russia, April/May 2014. Overview of physical exhibition: https://www.youtube.com/watch?v=eQeUf_Ua6EY – Accessed online May 28, 2014.

[31] Exhibited for the opening ceremony of the *"Coppelia"* sim (virtual property). Image provided with permission by Jo Ellsmere, April 29, 2014.

[32] The code for activating poseballs can be found here - https://marketplace.secondlife.com/p/HeZ-Multi-Sit-Script-Multiple-poses-and-sit-targets-in-one-prim-without-poseballs/370403 - Accessed online May 28, 2014.

Figure 5: "Pardon our Zeitgeist" (© 2012, Ellsmere & Kazyanenko. Used with permission.)

Composed as a non-verbal dialog between two geometrically abstracted SL-Bots, this performance used DM and some LSL code to trigger an automated sequence of choreographed emoticons. With this performance especially, Ellsmere explicitly represented each trigger as a coded command within the performance document script. Ultimately, Ellsmere had total control over the durations and visibility of each animation trigger. Further, Ellsmere had the SL-Bots "listen" to conversation scripts and when a cue was triggered, react by generating a new emoticon "prim" speech-bubble (Personal communication with Jeremy O. Turner, April 30, 2014). Ellsmere's mixed-reality performance collaboration with the Australian body-artist, STELARC, "OUT OF YOUR SKIN" (Stelarc/Ellsmere, 2012)[33] also exploited the affordances of DM Pro. However, as mixed-reality input, STELARC included "[…] scripted movements and mapped sounds which […] also featured [his] brainwaves and heartbeat and other analog sounds […] including white noise".[34] Similar to Ellsmere's earliest experiments with DM Pro performances, STELARC created SL-Bots that were choreographed to merge with each other's bodies. In this case, the bot-bodies represented "automatons" or "clones" of STELARC's physical "RL"[35] self[36]. Inspired by autonomic biological system reactions, STELARC's involuntary muscle movements were mimicked by one of the virtual agents.

[33] December 2013, Melbourne, Australia. Production Assistant: Daniel Mounsey.
"The title of the piece misstated by the videographer; several names in the credits were also misspelled!" – Jo Ellsmere, April 29, 2014. *"Stelarc – Discussion on 'Out of Your Skin' Performance"* by Alan Ford - https://www.youtube.com/watch?v=ikauPUYRbrk Published January 03, 2014. Accessed online May 27, 2014.
[34] Ibid: (06:02-06:24).
[35] "Real Life" in Second Life jargon.
[36] Ibid: (02:10-02:22).

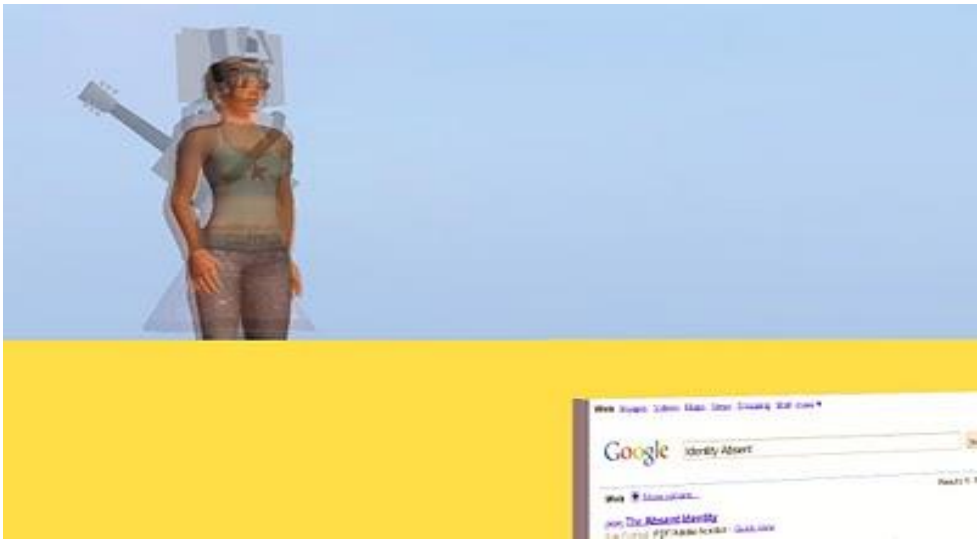

Figure 6: An SL-bot with Google "stage" by Selavy Oh in "Identity Absent". (© 2010, Selavy Oh. Used with permission.)

Selavy Oh's *"Identity Absent"* (Oh, 2010) is an immobile gender-ambiguous humanoid "script driven avatar […] that continuously switches its appearance between the 16 default appearances" available in Second Life. Oh's SL-bot also utilizes template humanoid body shapes and accessories. Coupled with Oh's "avatar", rests a kind of nearby webpage surface that approximates the form of a stage *[shown in* Figure 6~~*Figure 6*~~*]*. Correspondingly, this stage is also scripted but for a different yet related purpose. Essentially, the stage performs an automated Google search for the nametag of the nearest avatar/agent in closest proximity to this in-world web page. Oh's SL-bot can be subjectively perceived to possess varying degrees of ontological autonomy. In other words, Oh's agents are not actually autonomous. Rather, they invite the audience to perceive the agent's interactions as if they were acting autonomously Mirroring the "Open Source" movement of the coding community, Oh wants the audience members to shape her agents' hybrid identity as an "open work" (Eco, 1962) whose ontological interpretation can be freely manipulated by human-controlled avatars.

In the near future, one could envision Oh revising this piece to allow for additional interaction features. In one instance, the relative proximity of the avatar audience member could feed his/her UUID to this SL-bot so it could shape-shift into a visual clone of that avatar. This functionality that we have previously identified helps artists as it makes uniquely identifying entities much simpler (Weitnauer et al., 2008, p. 2). Most of the issues of designing SL-Bots right now are due to determining the appropriate level of cognitive abstraction for which percepts from Second Life's environment should be logically parsed into a tractable semantic representation by the SL-Bot's "unreliable sensors"[37] (Ranathunga et al., 2012, pp. 1–2). At present, it is difficult to determine how to interpret semantic meaning to sensory data in a direct enough way that an agent can teleologically interpret this data as being something useful, and with purpose. Generally, Oh's SL-bot could plausibly have access to a larger database of avatar designs – including non-human ones - that are tagged using keywords, proximity coordinates and UUIDs. Therefore, Oh's agent would not just exist without any distinct personality but would also provide a window of opportunity for the end-user to cognitively converge with the agent as a proto-gestalt "pure expression of personality" (Ranathunga et al., 2012, p. 97). Oh's more conventional SL-bot performance was *"Last Exit"*[38] (Oh/Turner

[37] An SL-Bot might experience "cognitive overload" and confuse its reasoning processes if it is overwhelmed by too much lower-level information from Second Life (e.g. avatar position,, avatar position, proxemic coordinate information etc) (Ranathunga 2012:2).

[38] "*Last Exit*"(2010) - http://ohselavy.blogspot.ca/2010/03/last-exit.html

2010, Ars Virtua Gallery, Second Life, shown in Figure 10) – a collaborative endeavor with Jeremy O. Turner (shown posing together in Figure 11.[39] For this performance, a group of texture-less SL-chatterbots used persuasive text-string prompts and path finding coordinates with the goal of guiding avatar audience members through a gate to "the other side".

For his *"Whitenoise NPC"* series [Moswitzer, 2009, *shown in* Figure 7~~*Figure 7*~~], Max Moswitzer has created a similar meta-avatar SL-bot-system to "Identity Absent". However in this case, his SL-bot literally wears "freebie" inventory items as part of its evolving body-schema. Whitenoise NPC becomes the sum of its scavenged accessories. Whitenoise NPC is composed of modular mono-chromed (i.e. entirely white) bots that assemble into an over-accessorized generic and unadorned male humanoid form. Before being attached to the core-humanoid body, these inventory items are automatically whitewashed to match the depersonalized hue of Whitenoise NPC. In some instances, the bots accumulate so much "white trash"[40] that their humanoid form becomes visually obscured by the objects it wears.

Whitenoise NPC differs in a subtle way from Oh's "Identity Absent" because of its more explicit autonomous tendencies towards autopoiesis. However, this particular type of autopoiesis only simulates semi-autonomous procedures but does not genuinely achieve absolute autonomy. According to Ayiter (Alpha Auer in Second Life), autopoiesis (i.e. self-production) is "…the process by which a system recursively produces its own network of physical components, thus continuously regenerating its essential organization in the face of wear and tear" (Auer, 2009). The LSL-script that engineers Whitenoise NPC's "essential organization" is actually part of its gestalt body-schema and ontological identity. Moswitzer's inventory-collection algorithm literally shapes the modularity of its overall dynamic visual appearance. Furthermore, Moswitzer's systems-based entity conforms to the ideals of a "second order cybernetics" that "…emphasizes autonomy, self-organization, cognition, and the role of the observer/controller in modeling a system, recognizing the observed system as an agent in its own right, interacting with another agent, i.e. the observer" (Auer, 2009). The agents' uniform and minimalist visual appearance suggest a complete objectification and depersonalization from any sense of social uniqueness and agency that any one of these bots might one day possess. To compound the situation, Moswitzer's design choice insisted that these nude agents wear only template inventory objects – thus removing any sense of ontological autonomy from their pre-designed object-hood. Incidentally, Moswitzer seems to have also chosen to use templates as his agent-system's autopoietic body schema in order to emphasize the avatar/object selection-processes usually ubiquitous in other virtual worlds. In most virtual worlds, creativity is seen as a customization of modular template items and appearances that are configured and tweaked according to one's personal preferences (see Manovich, 1995, p. 5). Similarly, in Second Life, the use of templates is still a cultural norm as are compromises towards automation over autonomy.

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https://www.youtube.com/watch?v=DdXJnaMX_xM - Machinima by Jeremy O. Turner, March 26, 2010.

Web content accessed May 30, 2014.

[39] This was the first public collaborative performance for the lead author's SL-bot, "Qiezli". However, Qiezli at this time was manually controlled as an avatar, rather than possessing automated or autonomous AI capabilities.

[40] Pun intended by Max Moswitzer.

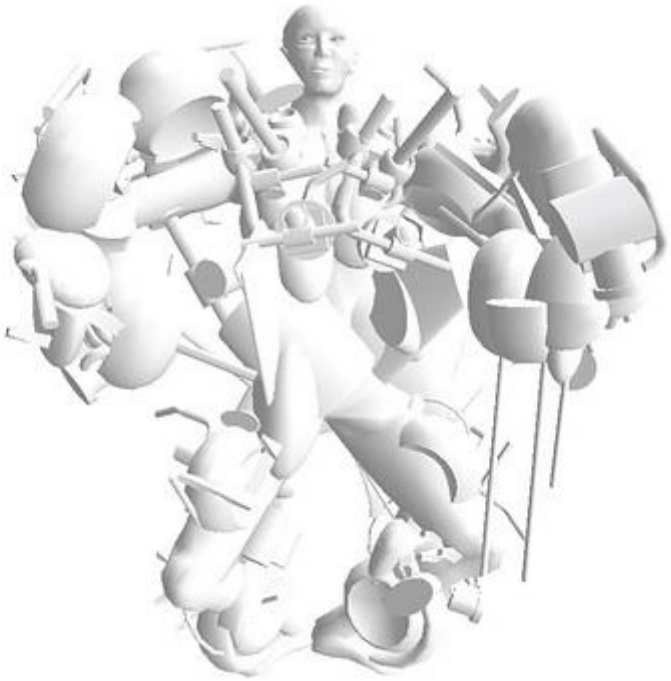

Figure 7: "Whitenoise NPC" from http://mosmax.wordpress.com/2009/04/28/semiautonomous-puppet-architectonics/ (© 2009, Max Moswitzer. Used with permission.)

Figure 8: SL-Bots conversing during the “LPDT2” installation in 2010. (© 2013, Ayiter, Glasauer, & Moswitzer. Used with permission.)

One ambitious SL-bot project acted as an official sequel to Roy Ascott’s canonical asynchronous teletype chat-room performance on the subject of distributed authorship, *“La Plissure De Texte”* (1983).

"LPDT2" (Ayiter/Glasauer/Moswitzer, 2010) featured SL-Bots[41] whose algorithm[42] could dynamically parse text-strings – that were inputted by manually controlled avatars[43] - for both communication and aesthetic self-ornamentation *[shown in* Figure 8~~*Figure 8*~~*]*. These SL-Bots' primary role was to act as "communication nodes between the narrators" and automatically distribute the collective authorship from text-strings originating from multiple literary sources (Ayiter, Glasauer, & Moswitzer, 2013, p. 4). These partially generative text-strings were drawn and remixed from: a corpus of literature classics harvested from the Project Gutenberg[44] website, human-controlled avatar text-string inputs, SMS text-chats and twitter feeds (Ayiter et al., 2013, p. 4). These SL-bots acted effectively as literary facilitators but it was the installation portion showing the massed participatory text in the form of chat-responses, and dynamic floating block text-objects for ornamentation that were the real defining features of Ascott's virtual-world sequel. The randomization of sentences from the literary corpus provided a compelling illusion of intellectual/cerebral autonomy and the randomization of actions indicated a clever way to bypass the limitations of a finite-state architecture.

Artistic Attempts Towards SL-Bot Autonomy

[41] These SL-Bots initially resided in Second Life but later were populated inside of an Opensim called the *"New Genres Grid"* (Ayiter, Glasauer, & Moswitzer, 2013, p. 3).

[42] The algorithm is as follows:

"1) choose a random text from Project Gutenberg and then randomly select a sentence as the starting point,
2) take the longest word in this sentence and search for this word in another text, again randomly chosen from Project Gutenberg,
3) once the word is found in the new text, take the sentence immediately succeeding the sentence containing the word,
4) take this succeeding sentence as a new sentence to be added to the generated text,
5) continue ad infinitum[…]" (Ayiter et al., 2013, p. 5).

[43] (Ibid:2-3).

[44] The artists chose Project Gutenberg because this "[...] repository holds over 30000 texts which have been authored by countless individuals throughout history." (Ayiter et al., 2013, p. 4)

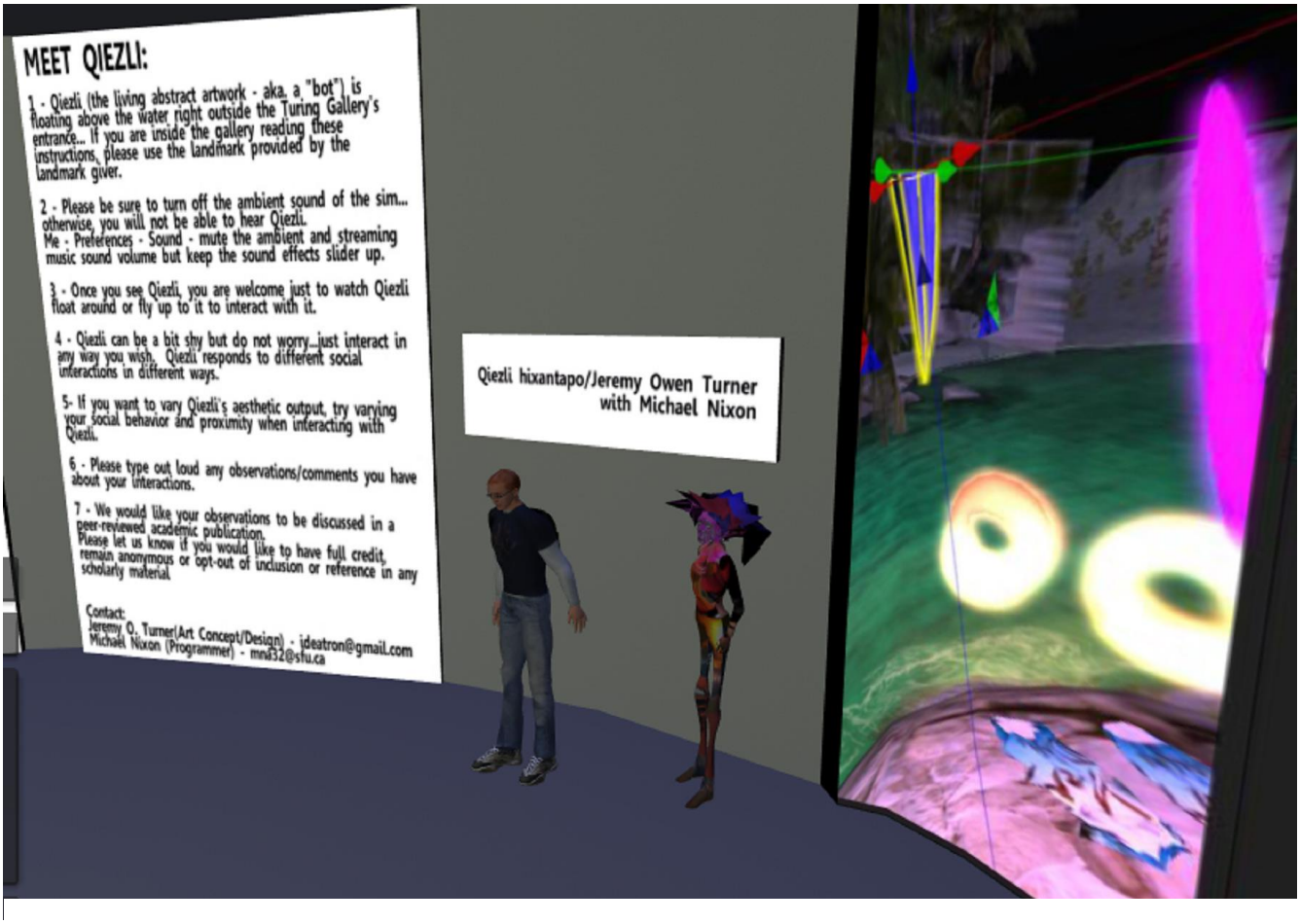

Figure 9: Didactic panel presentation showing Qiezli in the "Systems of Existence" exhibition at the Turing Gallery on Extropia Island. Curated by Kristine Schomaker in December 2012. (© 2012, Turner & Nixon.)

Figure 10: Selavy Oh posing with Qiezli's more abstract configuration that shows some of the early skinned and illuminated video textures – "Last Exit" - March, 2010. (© 2010, Selavy Oh and Jeremy O. Turner. Used with permission.)

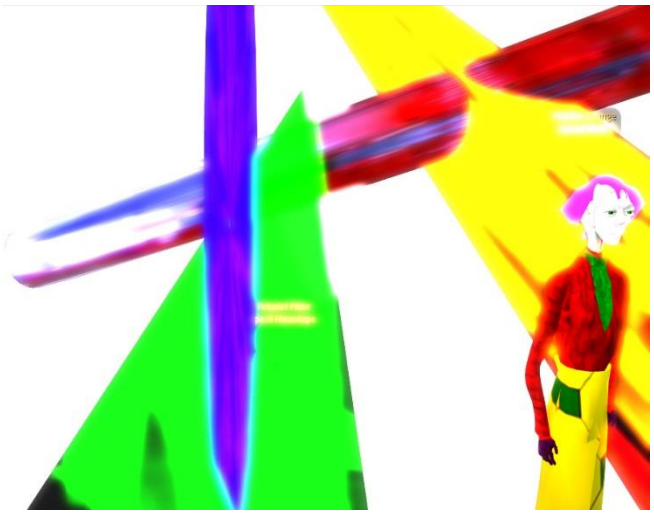

Figure 11: Qyxxql Merlin (i.e. Qiezli's "alt" avatar, on the right) poses alongside Qiezli's shifting abstract video configuration – "Last Exit" - March, 2010. (© 2010, Selavy Oh and Jeremy O. Turner. Used with permission.)

We now discuss examples where there were some design-intentions towards autonomy – rather than mere automatic processes. However, we concede that these attempts – although with genuine intent – produced at best, rudimentary results. These results do open the line of inquiry and praxis towards increased innovation in both AI and AGI fields.

Qiezli (Turner/Nixon, 2010) is a zoomorphic geometrically abstract and modular cloud-mass with the ability to transform the appearance and resolution of its limbs. Qiezli is a virtual being whose exposed skeletal-frame is composed from perpetually transforming illuminated textures *[shown in* Figure 9~~*Figure 9*~~ *and online (Turner, 2012)]*. Designed to function as a living discrete performance-art entity, Qiezli's teleological purpose is purely aesthetic rather than practical. Qiezli exists to "strongly express [...] a personality". Qiezli was not intended as an AGI-level implementation that intends to, as Mateas frames it, "fool the viewer into thinking [it is] human" (Mateas, 1997 cited in Anstey, Pape, & Sandin, 2000, p. 77). Qiezli's AI architecture, however, was designed to possess a rudimentary level of autonomy while its abstract body transformations employed combinatorial creativity (Boden, 1999). Qiezli demonstrates this crude interactive trajectory toward autonomy through oscillating "mood" states, its ability to scan avatar UUIDs and via its emotional threshold function.

Qiezli randomly roams Second Life, scanning its environment and occasionally displaying a non-anthropomorphic animation (such as those reserved for animating vehicles in Second Life). It materializes ("rezzes") up to six large-scale textured prims as part of its inter-changeable body while roaming. While no interactors are detected by Qiezli's gaze, these large-scale prim-limbs are rezzed with bright colours but no animations. Once entities are sensed, Qiezli will change its mode of selection and presentation.

When encountering scripted objects (whether alone or in the possession of an avatar), Qiezli then scans that object's barcode and retrieves that object's owner's personal UUID in order to display the owner's profile page as an image texture for one of its "inspired" prims. In the meantime, Qiezli will also consult its inventory for similar UUID strings. Whenever such scripted objects are encountered, Qiezli can retrieve that object's UUID and use this encrypted string as "inspiration" for particular objects in its inventory. Such "inspired" video-prims (symbolically expressed using the more abstract purple-pink and green colour spectra) reflect a switch from a purely self-reflective state.

Qiezli possesses a pair of cartoonish anthropomorphic eyes. These eyes utilize an embedded script that uses the llSensor() function to scan along their rotational axis. Qiezli uses its eyes to detect the presence, proximity, and velocity of other avatars and agents. When at least one entity has been detected, Qiezli switches its binary state from "solitary/daydreaming" to "social/presenting". When observing one avatar, Qiezli's body prims will display video-textures that depict close-up portraits of single avatars. However, when more than one virtual entities enter Qiezli's gaze, Qiezli derives its video-texture content from videos of groups of avatars. When no virtual entities are within Qiezli's gaze range for a fixed duration of time, Qiezli switches back to its solitary/daydreaming state. Qiezli's portrait-assets are not reflecting back the avatar interactor's own self as these assets have been pre-recorded. Therefore, these portraits are not directly correlated with Qiezli's real-time gaze as in the manner of functioning as a "transforming mirror". Rather, Qiezli is similar to a context machine only in that Qiezli does "not focus on [a particular] viewer but reflect[s] the whole visual context of the [art]work back onto itself" (Bogart & Pasquier, 2013, p. 116).

In terms of cognitive ability, Qiezli uses four "emotional" conditions during the social interaction process. Inspired by the SOAR (State Operator and Result) cognitive architecture (Laird, Rosenbloom, & Newell, 1986, p. 17) with its four types of impasse ("no-change, "tie", "conflict", "rejection"), and Anstey's four emotional categories ("praise", "encouragement", "criticism", "explanation") (Anstey et al., 2000, p. 75); Qiezli's social conditions are ambient, passive, conversational and hostile. If virtual entities have left Qiezli's gaze range for more than a minute, Qiezli will activate the random roaming animation as part of an ambient condition and depart at a slow velocity but will continue scanning for new avatars/agents while running its daydreaming loop. The passive condition is publicly expressed if the detected virtual entities are still within Qiezli's gaze range but have been idle for at least two minutes. After this period of lengthy idleness, Qiezli switches back to its solitary/daydreaming mode, re-activates the roaming animation, departs at a random velocity and delays any re-scanning for new avatars/agents for 5 minutes. This delay is intended to reinforce the interpretation that Qiezli has come to the conclusion that others are uninterested in its artistic presentation-performance. Therefore, Qiezli eventually lowers its saliency values (from the lead author's perspective, Qiezli appears "bored") and returns to its self-absorbed daydreaming state. The conversational

condition is met if the detected virtual entities are not idle but move around at a very low velocity and with little or no visceral interaction (collision) with the video-prim limbs. Under this condition, Qiezli will present video-prims with the colour scheme that matches the current level of interaction/collision. For example, the more each prim is touched, the redder it will get. Unless the other three conditions are met (ambient, passive, hostile), then Qiezli will engage in this presentation mode for a random duration of time. After which, it will re-activate its roaming animation and depart at a random velocity. If the agents/avatars cross this comfort threshold by making all of Qiezli's 6 video-prim limbs completely red, Qiezli's will perceive this behaviour as a hostile condition and initiates a contingency plan. Under this condition, Qiezli immediately switches to its roaming animation while intentionally avoiding those "hostile" avatars and escapes at a much faster velocity than in the passive mode. Then, Qiezli "sulks" and delays re-scanning new avatars/agents for at least 5 minutes.

Fundamentally, Qiezli's content-storage capacity, behavioural mechanism and cognitive architecture are scalable so this agent will likely be given eventually implement increasingly complex cognitive functionality and aesthetic possibilities. The scalability of content and behavioural/cognitive aptitude might one day correlate with an enhanced perception of creative agency by others. Virtual agents inspired by Qiezli's aesthetic and technical design could eventually be perceived as truly 'autonomous' and employ more explicit cognition models rather than simulations of autonomous behaviour.

Figure 12: The SL-bot Karl Marx from "Dead on Second Life" (© 2007, Iaconesi. Used with permission.)

The Italian media-art hacker Salvatore Iaconesi (aka. "xDxD vs. xDxD") has created a species of culturally recognizable humanoid SL-chatter-bots with logic-enhanced AI capabilities and via an Artificial Intelligence Markup Language (AIML) database. AIML chatter-bots such as "Alice" have a relatively long history, as they have been around since 2001, and are still being improved as AIML 2.0 was released in 2013 by Stephen Wallace. However, AIM combined with Iaconesi's use of the XSB Prolog logic architectures suggests future autonomous interactive possibilities for SL-bots. This SL-bot performance-art series is called *"Dead on Second Life"* (Iaconesi, 2007) *[shown in* Figure 12~~*Figure 12*~~*]*. These SL-bots represent virtually embodied personality proxies of philosophical, literary and cultural celebrities such as Karl Marx, Franz Kafka, and Coco Chanel.

Just as we conceptualized Qiezli, Iaconesi considers the property of "autonomy" important to his SL-bots. For Iaconesi, "each character has been recreated as an autonomous agent in Second Life's virtual world. The agents travel autonomously through Second Life, walking and flying at [their] own will, seeking some company in the form of in-world avatars" (Iaconesi, 2007). Each celebrity chatter-bot randomly teleports and roams around virtual properties and when encountering an avatar, retrieves "his/her" text-chat responses off-grid from the entire corpus of each authors' collected writings. The logic component of the database is to ensure that the text-responses are produced from that particular personality's original literary or philosophical corpus and that these responses are semantically and linguistically appropriate to the questions asked by an avatar. Further, each SL-bot can rudimentarily reason about the semantic content of each text-chat thread. Therefore, Iaconesi is showcasing the concept that chatterbots in Second Life are meant to be "inhabited by unique human personalities" (De Angeli, Johnson, & Coventry, 2001, p. 3). To clarify, the uniqueness of each SL-Bots's personality is provided by the semantic and literary content of the text-responses provided by each character's personal corpus. The SL-bot celebrities themselves would listen, record, archive and compile text-strings from the avatar audience interactions public channel. The purpose of this compiling process is to prepare a batch of new text-input in the markup database from which Iaconesi could manually formulate new responses lest the agent meets these same avatars in a future meeting.

State-Of-The-Art In The Non-Artistic Domain

In the non-artistic and non-celebrity realm, Selmer Bringsjord's AGI-research team at the Rensselaer Polytechnic Institute has made as an academic demonstration, their own SL-bot personality *"Eddie"* (Bringsjord et al., 2008). In principle, Eddie extends Iaconesi's SL-chatter-bot conventions[45] for the purpose of moving closer to genuine autonomous human-like: perceptions, beliefs, emotions and behaviour. Simulating the logic of human-children, Eddie can possess false and true beliefs about the world with limited degrees of maturity. Eddie might be a pilot-project but has already demonstrated some cognitive ability to "[…] understand, predict and manipulate the behaviour of other agents and human players" (Ayiter et al., 2013, p. 16). Eddie's complex affective thought processes attempt to accomplish near-human level capability through the assistance of arcane specialized AI-programming languages such as "Applescript"[46] and "Common Lisp"[47] as well as an automated theorem prover from the Stanford Research Institute known as "Snark"[48] (Bringsjord et al., 2008, p. 90). Despite Bringjord's encouraging

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[45] Outside of Second Life, however, Iaconesi created a similar agent to Eddie called "Angel_f".
This chatterbot learned natural-language chat-capabilities via using a spyware program to record a user's web-browsing activities and assemble a corpus of text-responses.

Iaconesi, S. (2008). Angel_f. In *Computer Art Congress [CAC.2]*
Emerging forms of computer art: making the digital sense. Proceedings of the 2nd international congress
Toluca & Mexico City. March 26 - 28, 2008. Khaldoun Zreik & Everardo Reyes García [Eds.]. ISBN 978-2-909285-45-6, pp. 155-160.

Iaconesi, S., Persico, O.(2008). Technologically-aware Ecosystems in Art and Society. *In New Realities: Being Syncretic.*
Ascott/Bast/Fiel/Jahrmann/Schnel [Eds.]. pp. 152-155. IXth Consciousness Reframed Conference, Vienna 2008. University of Applied Arts Vienna, July 03-05-2008. Wien: Springer Verlag.
ISBN 978-3-211-78800-5 360 pages.

[46] *"About Applescript"* – Mac Developer Library - https://developer.apple.com/library/mac/documentation/applescript/Conceptual/AppleScriptX/Concepts/ScriptingOnOSX.html - Accessed online May 30, 2014.

[47] Lisp (List Processing) was a high-level language originally invented at MIT by the AI-pioneer John McCarthy (1958). To understand the general-purpose instantiation of Lisp, "Common Lisp", please visit, *"Common Lisp – The #1 Programming Language".* http://common-lisp.net/ - Accessed online May 30, 2014.

[48] http://www.ai.sri.com/~stickel/snark.html - Accessed online May 30, 2014

cognitive developments with SL-Bots, the cognitive level of the most state-of-the-art bot is barely approaching the cognitive abilities of a human child.

One way to simulate more age-generalized cognitive processes is through an SL-Bot implementation of the popular BDI architecture (Rao & Georgeff, 1997). A BDI-Agent (SL-Bot) can draw from pre-authored or stochastically learned internal cognitive processes (e.g. emotions, thoughts) and/or empirically perceive external virtual events to "continually pursue […] multiple, possibly nested plans (intentions) to achieve goals (desires) in the context of up-to-date knowledge about the world (beliefs)" (Weitnauer et al., 2008, p. 3). Two established BDI-enabled SL-Bots are "Max" (Weitnauer et al., 2008) and a soccer player named "Jason" (Ranathunga et al., 2012). Going beyond Iaconesi's text-parsing chatterbot celebrities, Max is able to continually monitor his own emotional state at any given time. These emotional states are quantitatively weighted and are "[…] mapped to Max's facial expression" (Weitnauer et al., 2008, p. 4). Max also knows 2,000 plans that are derived from pairs of condition-action rules (Weitnauer et al., 2008, p. 4) Max can use these rules to dynamically update his knowledge about the world including: "[…] object and avatar positions, status updates, avatar appearances, avatar profiles, chat and instant messaging, as well as changes of friends and inventory status" (Weitnauer et al., 2008, p. 5).

Jason is named after the JASON[49] BDI (Belief Desire Intention) interpreter that he uses to interact with LIBOMV libraries. Jason also can rationally distinguish between higher-level and lower-level Second Life information. Jason can then use this categorized semantic interpretation of this information in the service of its pre-programmed beliefs, desires and intentions. With his rational and belief structure, Jason can predict and prioritize the most actionable percept-sequences it receives from direct interactions with the Second Life environment. Jason can even simulate more complex cognitive behaviour by having LSL and LIBOMV work in tandem to episodically produce a semantic "snapshot" of its immediate Second Life environment (Ranathunga et al., 2012, p. 6).[50] Using LSL, Jason may react directly partially available sensory data (e.g. touch activation only). Or, Jason might choose to be more patient by logically contemplating the rate of change in a more autonomous manner by gradually receiving *"contextual information"* (Ranathunga et al., 2012, p. 10). This type of information includes ontological updates and context-dependent rules from LIBOMV and the JASON BDI Architecture about the status of virtual entities/objects/identifiers. Jason can also determine when its goal and belief structure is being subverted by stochastic events in the Second Life environment and modify its next action-sequences accordingly.

Despite their complex goal and emotion structures, Max and Jason still represent general templates of social humanoid SL-Bots. For more aesthetic or advanced applications, the customization of idiosyncratic personality characteristics and levels of reactivity are contingent on the creative authoring of each SL-Bot's particular beliefs, desires and intentions (Ranathunga et al., 2012, p. 3). Despite these significant advances in SL-Bot behavioural design; there still remains much growth in both chat-based virtual worlds and NPCs in video-games where AI-capabilities can truly provide meaningful aesthetic interactive experiences in open-worlds like Second Life at an adult-human level or beyond.

[49] JASON is a Java based interpreter for *"an extended version of AgentSpeak"*. http://jason.sourceforge.net/wp/ - Accessed online June 04, 2014.

[50] Weitnaur et al's Max also uses an external library for a similar purpose. The only noticeable difference is that Max uses "libsecondlife" instead of "LIBOMV" and does not explicitly mention how this Max might integrate libsecondlife and LSL into a holistically integrated snapshot of the virtual world.

Aesthetic And Social Significance For Next-Generation SL-Bots

This historical research into the state-of-the-art for SL-Bots has heuristic utility for bot-creators and automated performance artists in Second Life. This chapter articulated the limitations of finite-state machines in SL-Bot bot design so that avatar artists today could brainstorm ways in which the technical functionality of LSL could be expanded. Ultimately, such suggestions could inspire and evolve the next versions of Second Life. Further, next-generation worlds independent of Second Life might also improve upon Second Life's limitations and allow a new species of bot – for aesthetic purposes - that has the capacity for Artificial General Intelligence (AGI).

Currently, SL-Bots's finite-state architecture implements a narrow or weak category of single-purpose Artificial Intelligence. At best, single purpose agents such as SL-Bots are only minimally "intelligent" within the context of pre-determined roles that depend on persistent social interactions with external forces for its perceived personality-development and unique characterization. In other words, SL-bots have a strictly reactive personality and are directly shaped by an avatar, another bot or the environment. This is why SL-Bots are ideally suited for subordinate social roles such as a "greeter" or a "tour guide". This is also why SL-Bots are seen as automated rather than autonomous characters.

In contrast, AGI foregrounds principles of autonomy, autodidactic learning, and autopoeisis. The goal of next-generation agents is to fully simulate and implement human-level capabilities (Goertzel & Pennachin, 2007, p. VI). Such capabilities include at the very least, the ability to communicate fluently using natural language, to learn independently (Voss, 2007, p. 132) and to achieve some level of self-awareness and common-sense reasoning. Such capabilities at minimum, will allow SL-Bots to achieve a social baseline for human-level believability and make Second Life (and equivalent next-generation worlds) "level the playing field" between avatar and agent (bot). With such a level playing field, social interactions between the automated and autonomous will become more emotionally and intellectually dynamic. Truly autonomous SL-Bots would evolve from being mere automated social representations of roles, personalities and archetypes from "real life". The eventual implementation of these evolved synthetic beings would help fulfill the Modernist aesthetic ontological imperative that art should be free from social representation and literally "be itself".[51] Within such a formalist aesthetic framework[52], SL-Bots would also possess the capability to teleologically function as "living art-work", instead of acting as token personality simulations, postmodern references, service workers and personified props.

Regardless of aesthetic teleology, Second Life and other social virtual worlds can use AGI-enabled SL-Bots to help enhance their ontological distinctness from ludic-obsessed video games. Opportunistic artists making SL-Bots as believable as humans might possibly draw in more human audience-members and interactors to social based virtual worlds than video-games – unless next-generation video-games themselves also incorporate such AGI heuristics for their NPCs. Currently, there is a trend towards lifelike computer characters for all sorts in simulation purposes that started in the late 1990's, and the research agenda of the Oz Project at Carnegie Mellon University both exemplified and helped to define it. Their 'broad agents' (Bates, Loyall, & Reilly, 1994) incorporate human-like behavioural and emotional components to portray believable characters. Badler, Allbeck, Zhao, and Byun (2002) call the "creation of effective real time autonomous embodied agents" one of the "last research frontiers in computer animation."

In Loyall's work (1997), he provides a definition of believability that demonstrates the variety of disciplines that come to bear on this new computational problem: believable agents must concurrently pursue parallel actions, be appropriately reactive and responsive, be situated, be resource bounded, exist in

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[51] Kant 1790, Greenberg 1940, Judd 1965.
For AGI interpretations of teleological finality, read: Dewey, D. (2011). Learning what to value. In *Artificial General Intelligence (pp. 309-314).* Springer Berlin Heidelberg.

[52] The Modernist/Formalist approach is not necessarily the only advocated approach. However, Modernism does lend itself more towards critical perceptions of aesthetic autonomy than Post-Modernist and/or more context-centered approaches.

a social context, be broadly capable, and have well integrated modes of communication. To be broadly capable, he states that agents must portray a personality, display emotions, be self-motivated, change over time, experience social relationships, be consistent, and maintain the overall illusion of life. This requires providing agents with the attributes of autonomy, social ability, reactivity and pro-activity (Wooldridge & Jennings, 1995b). To do so reframes the traditional agent research agenda to include a variety of expressive communication modalities as well as efficient task-completion. We believe that this goal of believability is key to creating artificial agents that both think and act humanly. However, if this cognitive baseline is reached, we believe that virtual worlds such as *Second Life* provide an artistic context where SL-Bot creators might one day create aesthetically dynamic "unbelievable" characters that appear more than "merely" human.

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