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Artifact and Artifice : Building Artificial Life for Play

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Abstract

Toys and play-things are often engineered to replicate the character of real organisms. In the past, inventors often lavished great expense on their life-like automata, their constraints typically related to the mechanical technology they employed and the amount of time and effort they were able to commit to the enterprise. The devices which are currently produced are usually intended for the mass-market. The cost of production therefore is a major concern, even though the technology is more sophisticated and highly automated than in the past. Consequently, toy makers and engineers, as well as artists, of the past and present alike have had to think abstractly about living systems in order to economically construct their simulacra. This paper examines a number of life-like toys to discover the properties of real organisms which their designers have attempted to recreate. That we, as users of these devices, so readily recognize in them a degree of life-likeness, demonstrates the extent to which intuition may sway our intellectual reasoning about real biology. As a result, an innovative toy maker or artist is able to manipulate us to zoomorphize even the most extreme abstractions – at least momentarily — despite our rational reluctance to accept the trickery.

Keywords: Aibo; android; Tamagotchi; virtual pet; toy.

1.0 Introduction

As children we may have played with plastic farm animals, toy soldiers, talking or crying dolls, wind-up beetles or battery operated robots. Today's children laser-blast virtual alien life-forms or pilot leggy, busty, machine-gun toting women through dangerous mazes — the idea of simulating the appearance and behavior of living systems has been with us our whole lives, even if a label for it has not. In fact, throughout history replicas of life have been widely produced. As in archaeology, the construction and character of such artifacts may inform us regarding the way we perceive and interact with simulacra of life on a day-to-day basis.

Some ancient cultures, such as that of the Aborigines of Australia, attribute great power and life-spirit to painted images of living things. Others, such as the Yoruba of Western Africa speak of their creators as potters, literally shaping life from clay and breathing spirit into their sculptures. This is not such a stretch from the Medieval conception of the Golem of Prague, fashioned from clay and having the mystical word of life given to him by his Kabalistic creator. In the West, those who followed Science, may have followed Descartes' insistence that living things were clockwork or mechanical automata. This view being out of date, there are some now who insist that computer software may "live".

The history of technological innovation has brought with it more and more sophisticated

replicas of life. Some of these were created for religious reasons or as philosophical puzzles, others purely for the amusement of an audience or their maker. Some were created as demonstrations of craftsmanship, to win fame, or as part of scientific investigations into biology. Regardless of the reasons for their creation, these devices are useful in allowing us to place into perspective our current interest in digital computing machinery and living systems. They highlight too, how intuitively we respond to an artifact's particular life-like traits, regardless of its other characteristics. In particular, this is true of toys and more sophisticated artifacts built for amusement. It is these which form the subject of this essay. Therefore, this paper will glance at a few examples of early clockwork automata and proceed to examine some current toys and art works which are, by their nature, more visceral than most artificial life software developed for the purposes of research.

Vaucanson may be known to artificial life researchers for his famous automaton duck. By this he aimed to demonstrate that all actions necessary for eating, drinking and digestion had been exactly imitated [15]. In 1738, the inventor exhibited an automaton flautist to the Royal Academy of the Sciences in Paris. Whilst other automata existed that played keyboards, drums or rang bells, Vaucanson wanted his automaton to mimic a human playing a complex wind instrument – he wanted it to *breathe* [16, pp19-23]. Not only this, he wanted it clear that his automaton was a breathing *sculpture* and to this end its shell replicated the design and patina of a marble figure by the French sculptor Coysevox [15]. Automata produced by Vaucanson not only mimicked the ability of a human musician, they surpassed it in speed and accuracy, calling into question the assertion that humans were somehow superior to machines in the realm of musical performance at least.

Since no recordings of the android flautist exist, it is difficult to judge how *expressively* it played. This was not Vaucanson's aim however. He wished to "imitate by Art all that is necessary for a Man to perform in such a case" and he reveled in the ability of one of his flute-playing androids to perfectly tongue a bar of semi-quavers at speed, outdoing all human performers on the instrument. Reports of the day were favorable. The android played the German Flute "with an exactness which has deserved the admiration of the public and of which a great part of the Academy has been witness" wrote the secretary of the French Academy. It, "imitates a true player on the flute so perfectly" and is "one of the most wonderful productions of art" [15]. Vaucanson won considerable fame along with the title "modern Prometheus". Although it was possible for a machine to "breathe" air and, in the eyes of the Academy and general public of the time, play the flute as well as a human, could it match humans in intelligence? The question remained open.

The Chess-Playing Turk pseudo-automaton of Wolfgang von Kempelen, constructed in 1769,

was intended to "demonstrate" to the public that artificial intelligence had been created in concert with mechanical life [5]. This device played chess as well as the leading players of the time. In fact, the leading players of the time were hired to sit *inside* the machine and trick its audience. The ability to play a competent game of chess has long been considered a trait of an intelligent mind. What did it mean for human intelligence if what seemed to be a mechanical automaton could beat all-comers at their own royal game? Machines which breathed and played music and those which won at chess seemed to be evidence in favour of Descartes' hypothesis that lower animals were nothing more than complex automata. However it pressed the point that perhaps humans too were no more than complex machines. Worse still, it seemed that aspects of humankind could be *improved* upon using modern technology.

At a time when clockwork androids were appearing in droves, Jacquet-Droz built a writing automaton which, on occasion, is said to have scrawled Descartes' dictum, "I think therefore I am" and furthered this with, "I do not think… do I therefore not exist?" [16, p7]. Despite the flaws in the "reasoning", by inviting viewers to ponder the validity of its remarks, Jacquet-Droz's automaton served as more than a trifling amusement for the wealthy. This machine did not play music nor chess. Unsettlingly, it was reproducing the words of one of the period's leading thinkers. Did it have a soul? How could a viewer tell? One day, would an artificial device be able to communicate with a human directly in this manner?

Regardless of the current views we hold about life, its imitation and its synthesis, the lines we draw in the sand today may be washed aside by the tides in the morning — what remains of benefit is the act of questioning our views and reassessing our beliefs, and for this the toys and puzzles of the past serve as well as those of the present. The subjects of the remainder of this essay therefore are toys of the last few years and the particular aspects of living systems they highlight. The toys have been selected largely according to personal preference with an eye to exploring a wide range of devices, and the diverse characteristics of the organisms they mimic.

2.0 Mechanical movement in physical toys

The expense lavished on the creations discussed above was quickly recouped through charging society's elite admission to see them in operation. In contrast, since the assembly-line production of Edison's talking doll, mass-produced modern toys must be relatively inexpensive if they are to sell and recoup the cost of their design, marketing, manufacture and distribution. For this reason, toy makers are often forced to economize. Such economic concerns, as well as concerns about the feasibility of mass-construction, have led toy makers to think abstractly about life and to produce simple devices to recreate or represent it. Thinking abstractly about living systems is something at which some artists also excel. It

therefore comes as no surprise that the work of artists and toy makers in constructing replicas of life parallels the thinking of artificial life researchers to some extent. In the case of toys and art both new and old, the goal of the maker has frequently been to mislead the human owner or viewer of the artifact into believing the device is more complex than it really is.

Whilst the artifacts in the section above focus our attention on mimicking outer signs of the inner workings of living creatures, the examples in this section focus on our perception of a creature's movement. In these cases, many other details of the creature's behavior have been abstracted away.

We will start the discussion with a wind-up toy called the *Bonga* from Kikkerland (Figure 1). The clockwork artificial life toy is no longer a novelty since such automata have been play-things of children for many years. What makes the *Bonga* interesting, is the absence of "dressing". Although in body-plan it resembles a centipede and its wire legs are bent to make them look a little like miniature gum boots, very little effort is invested in decorating it to give the appearance of an animal. The *Bonga* is a bare metal box with eight plastic-capped rotating wires for locomotion. Its gears and steel spring are clearly visible. The only additions to the structure which serves no practical purpose are the rivet at the front (which seems to stand in for an eye) and the cut-out in the tail which supposedly is for aesthetic value but may also be to economize on cutting the steel side plates from a single strip end to end. Apart from this, *Bonga* is a walking machine, and that is "all".

Watching it force its way clumsily over obstacles and across table-tops one can't help but feel it is a "determined little creature". The toy gets "exhausted" when its spring winds down and it flails its "legs" wildly and helplessly in the air when it capsizes. Yes, this language is emotive, herein lies the fascination with the toy. Despite its undisguised mechanical nature, for humans the *Bonga* in motion elicits similar responses to a wandering beetle or perhaps a lizard. Would we take a hammer to it and violently crush it? A discussion of this issue appears in [7] which suggests we would probably find this behavior distasteful: the creature would seem so "helpless"; it would "writhe about in pain". It is easy for us to attribute determination to live to this little mechanical device. This may stand in our way if we should try to put a violent stop to its antics.

The toy snakes made of about ten hinged sections of plastic tube (Figure 2) connect us psychologically with the natural world for similar reasons to those initiated by the *Bonga*. In contrast to the *Bonga's* unadorned shell, typically these serpentine toys have plastic heads, eyes, and colored spots on their bodies in order to approximate the appearance of an animal. Such dressing is unnecessary. It is the movement and simplicity of the artifact which make

this a perennial favorite. The sickly smooth slithering of the snake is unmistakable, even when recreated in bright shades of plastic and even though the device is not autonomous but depends on the human hand to bring it to life.

Whilst *Bonga* and the toy snake depend on our visual senses to recognize their life-like movement, two Dutch artists, Erwin Driessens and Maria Verstappen, have created devices which caress humans. Due to the intimacy of physical contact, the sense of being touched by a living creature is even more powerful than that experienced when watching one move. How many of us have been paralyzed by fear as a wandering insect or spider touched us as we lay in bed at night? *Tickle* and *Tickle Salon* have won first prizes at the international artificial life art competition LIFE 2.0 / 1999 and 5.0 / 2002 respectively. *Tickle* is a small mobile robot with two motors, rubber caterpillar tracks, and a set of sensors to detect slopes and thereby remain on a person's back as it maneuvers around at 1.2 cm/sec (Figure 3). The controller for the robot is implemented as a hardware finite state machine.

Unlike a human partner, the autonomous *Tickle* will continue its tactile task reliably for a couple of hours – until its batteries need recharging. *Tickle's* life-like behavior primarily relates to the way it interacts with its environment – the surface of a human, through touch and movement.

To make their point more clearly, the artists followed this device with another artificial life creation constructed to caress humans, *Tickle Salon*. The artists remark,

> "The machine itself does not look like an organism the way Tickle does: it is attached (to the ceiling above a bed) instead of autonomously moving around. But its behavior is much more sophisticated and thoughtful (than Tickle's) as it learns over time. It has a 3-dimensional perception of space and can make complex movements through this space. It is truly a form of artificial life because it explores its surroundings, adapts and reacts to them in an intelligent and unforeseen manner." [14]

(Bracketed text added by the author.) *Tickle Salon* has a soft feeler which it uses to caress the human participant on the bed below, whilst it generates an internal model of the human's body plan through touch alone. The original *Tickle* was a purely reactive machine designed to wander around without falling off the human's body. The physicality of each of these works is a necessary criterion for their being able to interact with humans.

The *Bonga*, cylindrical snake and the *Tickles* are instructive for highlighting the role of physicality and interaction with the physical environment in our recreations of life. As discussed above, each of these artifacts involves abstractions about living systems. The life-like traits present in each are only a small subset of the characteristics we as artificial life researchers insist on. In some cases, the traits maintained are those which researchers may see as *unimportant*. Despite this, the shortcomings are easily overlooked and our intellectual

skepticism is contradicted by our gut responses to the devices.

The sense of animation in the artifacts above is strong. It is not mere wishful thinking on the part of their makers. This being the case, what features have artists and toy-makers sought in *software*-based artificial life? Are they the same features which interest artificial life researchers working with software? In light of the examples above, it seems that the possibility for physical interaction is a major shortcoming of screen/software-based artificial life. How has this been addressed by artists and toy makers?

3.0 Growth and development in software toys

Bandai's *Tamagotchi* and its derivatives such as the *Giga-Pets* from Tiger Electronics were popular toys with children and also, especially in Japan, with adults. The fascination with the attention-seeking virtual pets of the mid-nineties seems to have died out as quickly as it grew. A wide variety of Tamagotchi characters are available. They are all low pixel-count forms, animated within the constraints of the wrist-watch electronics which encapsulates them. They "live" on an LCD display housed in a pocket-sized plastic egg (tamago is Japanese for egg) which owners carry around on a key ring. As they interact with their human owners, these creatures develop along predetermined paths from virtual eggs to different adult varieties (Figure 4). What is the attraction of these devices?

One cannot sensibly discuss the success of the Tamagotchi without a remark about the Japanese obsession with *cute*, the local term for this is "kawaii". Whether it be Hello-Kitty, Pingu, Doraemon, Pikachu, or any of the countless other characters from Japanese popular culture, kawaii has ruled the day for more than twenty years in Japan. Tamagotchi characters were a part of this national obsession.

It appears from a thorough scan of the countless Tamagotchi (and anti-Tamagotchi) websites and even the artificial life literature [6], that the fascination with Tamagotchi comes in part from the dependency they have on their human. "It is dependent on you. That's one reason it became so popular," says Maita Aki the Tamagotchi creator, "I think it's very important for humans to find joy caring for something." [9]

These simple arrays of pixels must be "fed", "bathed" and "entertained" in order that they progress from newly-hatched youngsters to fully-fledged adults. The interactions with the outside world must occur through a simple push-button interface, and the complexity of the tasks required of the human keeper is trivial (e.g. select from an iconic menu to "feed" the creature, or engage in a simple repetitive computer game to "play" with it). The responsibilities of the human for their virtual pet are similar to those needed to keep a goldfish — the tank needs cleaning, the fish needs feeding, the lights need turning on and off

at appropriate times.

The departure of the virtual pet's spirit (or if you have the American version of the pet for thanatophobics, the departure of the pet from the game world), parallels the loss of a goldfish through neglect of its basic needs. If it weren't for this dependency, the Tamagotchi would have little to recommend it as a toy. Or would it? The graphics and animation are low-resolution, the audio is usually "chirpy" and the mode of interaction is tedious. As far as the user is concerned, what is important is not "what is", but "what is perceived to be." As Baudelaire notes, when it comes to children and their toys, "The soldiers can be corks, dominoes, draughtsmen, knuckle-bones, the fortifications may be planks, books, etc. the missiles marbles or anything else you like; there will be dead bodies, peace-treaties, hostages, prisoners, tributes to pay" [3]. In the case of the Tamagotchi, it doesn't really matter whether the virtual creatures *look* real. What matters most in this case is that they are kawaii and dependent on the human.

Some of the later model toys of the Tamagotchi type, such as Parex Electronics' *Linkable Virtual Pets* incorporated mating and game play between the virtual pets. This was facilitated by a cable link between two of the toys. The cynics will say this was a clever marketing plan to encourage interactions amongst pet *owners* who then needed to go out and buy the toys in order to be part of a social group[1]. All the same, various points of interest to this article come into play. For example, the importance of sexual reproduction is being reinforced, the need for two creatures to reach maturity is replicated, and the relationship between the creatures must evolve through a number of stages: friends; lovers; and apparently a (shotgun?) wedding; after which time the female falls pregnant. A virtual kitten arrives a few days later. The two characters may also, with some assistance from their owners, engage in a friendly game of digital tennis.

Equivalent linking pets targeted at young males included the *Nano Fighter Pets*. *Nano Fighter Pet* owners "train" their toys and, when they think their pets have sufficient strength, plug their toy into one or more daisy-chained units belonging to their friends. The attached units then do battle and one is declared the winner. The others need nursing and regular care to recuperate. (This procedure parallels that applied to the *BIO-Bugs* discussed below.) The fights are not under human control, they are left to the creatures themselves. The human's role is only to prepare the pets for battle as we have trained and bred pit-bull terriers, fighting

[1] This is born out by the introduction a year after the Tamagotchi craze of the *Lovegety* [1]. These devices are about the size of a Tamagotchi. They do not contain virtual pets, instead they broadcast the presence of their male and female owners, as well as his or her mood, to other owners of the same gadget in a radius of a few metres. If the toy owners like the *real* mates they have found, the couple can head off to sing karaoke or skip the formalities and "Get2" it.

cocks and Siamese fighting fish in the past.

4.0 Interaction between software and the physical environment

Of all of the electronic creatures contained in pocket-sized boxes, one of the most innovative is *Bitman* from the Maywa Denki art group in Japan (Figure 5), producers of some exceedingly cute (certainly kawaii), bizarre, occasionally repulsive artificial life toy/art pieces. *Bitman* is a human stick-figure which appears on an 8x8 pixel LED display, in an elegant, square, palm-sized, one-button, one-dial white rubber-surfaced box.

The interface between *Bitman* and the outside world is an excellent piece of design. Simply tilt the box to one side or the other, up or down, or shake it vigorously and *Bitman* responds. He may dance to different rhythms (played in quirky electronic tones from a small loudspeaker) and at different speeds, or he may jump up, down and around his 8x8 grid-world. If you hold the box upright in front of you, then rotate it clockwise or anticlockwise, *Bitman* walks around the edges of his world. He does this in such a way that he always stands, dances or jumps upright – he is subject to gravity. Quite a feat for an electronic character!

Whilst the symbolism of the stick figure and the terrific animation (given the limited resolution of the device) persuade the human to identify *Bitman* as a "character", what is most appealing is his immediate response to the orientation of his container. This simple deception goes further towards making the character appear rooted in the physical world than many of the more complex attributes given symbolically to other digital pets.

Virtual pets built for roaming about on a computer desktop, the *eSheep* for example, may seem to be subject to gravity also. This can be confirmed in the case of an *eSheep* by iconizing a screen window from beneath its feet and watching as it plummets down screen to the next horizontal window top or the bottom edge of the screen. However, the eSheep does not share *Bitman's* pseudo physicality.

Bitman's symbolic representation enable*s* him to appear to us to behave "realistically" and with fluidity. Since we interpret the symbols used to represent him transparently, without conscious effort, his limbs are not restricted to clunky movements governed by mechanical actuators and motors. Instead his body configurations are interpreted as "fluid-icons" and the physical impossibility of his antics becomes irrelevant.

Additionally, *Bitman* encourages physical movements/activity in the human, something which desktop creatures essentially eliminate. Not only does this occur as discussed above, through shaking the *Bitman* housing by hand, the box is also intended to be accessorized with a necklace, or a watchband. The active human owner may then wear *Bitman* on the street or to a

night club as a fashion accessory where he will respond to his owner's movements. *Bitman* worn in this way becomes a travel companion which responds to the physical conditions on the journey, something which the Tamagotchi is not designed to do.

Whilst Tamagotchi are not built to respond automatically to their environment, the human tendency to anthropomorphize may overcome this limitation. For example, some years ago, I bought a Giga-Pet kitten – *Nano-Kitty* – during a visit to the USA. I looked after it on my trip, and brought it home with me on the aeroplane. I had set the toy's clock when I was in the USA and I was now asking the toy, as I was asking myself, to adjust to the time differences between Australia and the USA.

Anyone who has made an international flight across time zones will realize the difficulty one's body has in adjusting to the change. In this instance, I tried forcing the Giga-Pet's body-clock to do likewise — without success. It would wake up after I had turned its house lights out. It wanted to play when I was trying to sleep. It woke me with its incessant beeping to be fed at 4 am. The little kitten drove me crazy until finally I gave up tending to it and left it in my desk drawer. My pet got terribly ill and still I didn't care for it. Eventually *Nano-Kitty* packed up its belongings in a clean handkerchief tied to the end of a stick. It then wandered dejectedly off into the ether, leaving my pocket-sized plastic egg-world desolate.

In this case, the toy's response to the changing time zone was (of course) enforced by my own attempts to adapt. Since the toy's refusal to adapt mimicked my own body's reluctance, it was easy to be sympathetic to its (lack of) response. I therefore considered the toy to be "jet-lagged", a description which of course is anthropomorphic, but, as is typical of such descriptions, is also quite satisfactory to the human as an explanation for its behavior. Scattered about the WWW are other examples of children in particular, writing up their experiences with the Tamagotchi and explaining the behavior of their pets in similar ways. This raises the next question for this essay to address.

5.0 Giving life and taking it away

The Tamagotchi craze raises the question, are there differences in the behavior of children when they interact with virtual and biological pets? Some have suggested we teach children that life and death are reversible processes by giving them virtual pets with on, off and reset switches. They suggest that children learn that a pet's life may be temporarily suspended when its care is inconvenient or requires too much time and effort [13]. The opinion of one Tamagotchi hacker from the late nineties differs,

> "I certainly don't think that mucking around with Tamagotchi is in any way a precursor to trying to reset the timers on your children. There is a real distinction that must be made, and

> all-too-often isn't, between real-life pets/children and computer games. Tamagotchi are nothing more than fairly simple computer games and should be treated as such. Most rational people will be quite happy to accept this discrepancy, and it's only media hype by the manufacturers and journalists looking for a shock-story that is drawing the virtual pet, (real) pet parallel." [12]

In this vein, an online petition caught my attention,

> "**A Sea-Monkey is a living pet, not a toy!**
>
> To: All designers and manufacturers of Sea-Monkey products
>
> We, the undersigned ask all designers and manufacturers of Sea-Monkey products to bear in mind that Sea-Monkeys are actual living creatures and should be treated with the respect they deserve. We believe products such as pendants, pens, key-ring maze games and watches cause unnecessary suffering to these small crustaceans. The swimming space within these products is small, and they are, by their nature, designed for rapid movement, which can only result in injury. As they are watertight there is no way for air to enter the water.
>
> We also believe it is irresponsible of designers, manufacturers and distributors to sell kits to the general public which do not contain air pumps, which are critical for the survival of these pets or comprehensive instructions such as are found in the official Sea-Monkey Handbook." [10]

Sea-monkeys are a species of Brine Shrimp which may stay in suspended animation for many years. (The company which markets them for pets has tellingly registered the term *Instant Life*.) The marketing of these creatures as "toys" by some profiteers, without adequate measures being taken to provide for their well-being, has been problematic at least for some of the 1800 signatories who seem to be engaged in an amusing, often childish, sometimes heated and a little too serious battle with those who think the petition is a complete farce.

In contrast to the pleas of Sea-Monkey activists, an infamous norn torturer writes on his website:

> "Many forms of torture cause physical injury of some kind. More injury means more damage to the norn, which shortens their lifespan. As *Norn Abuse* is fond of pointing out, death is a release for a tortured norn, and some people might not want that. Yes, it is fun to torture a norn to death, but it can also be fun to see how long you can keep a norn alive under abusive conditions. The *RedCross cob* automatically injects all norns in range with organ healing compounds (prostaglandin and vitamins), and antibodies for all known antigens (if you are torturing a norn, you don't want to have to waste time nurturing it back to health from an illness, do you?). Place one of these in your norn's cage, make sure the creature gets plenty of food and rest, and you shouldn't have to worry about its health." [2]

The norns, created by the now defunct company Cyberlife/CreatureLife, are PC-based virtual pets drawn with wide eyes and droopy ears. Anti-Norn, the owner of the norn torture website, has apparently received a substantial amount of abusive hate mail, even death threats for the experimental "torturing" of his virtual pets. For awhile the topic was hot on internet newsgroups and in chat rooms, it even made it into the occasional computer section of the mainstream press [4].

Is this interaction significantly different from that of the video game player who machine-

guns, karate-kicks, eats or knife-slices his opponents? It seems the "torturer" struck a raw nerve with his actions. Somehow these must differ in the mind of the game-playing community from those usually associated with a video game — or perhaps I'll soon locate a "Save the ghosts from Pacman" petition.

The issues concerning virtual torture become somewhat more murky when the life of virtual characters cost players time, energy and/or real money to develop and maintain. When a parent spends $1000 on eBay buying a "powerful" but nevertheless *virtual* character for their spoilt child to use on *Everquest*, a popular Sony role-playing game, the parent attributes a concrete value to the virtual life form. This value exists independently of moral and ethical concerns about the value of the virtual character's "life", but is related to the amount of real energy a player must invest in establishing a character of that caliber in the game world.

If the child's character is "killed", "tortured" or "slaughtered" by the characters controlled by other players, the pattern of data which represents it has been altered in a significant manner. That is, the data has been changed from a state where the player may use it to interact with other characters in the game world, to one which is no longer responsive in this way. This amounts to destruction of property, albeit in an environment where this is an expected outcome of participation. The fact that his character's "life" has been taken, may also have a significant effect on its guardian.[2]

In the physical world, the destruction of a symbol can have a powerful effect which far exceeds in importance the destruction of the material from which it is made. For example, a burning effigy or a flag trodden in the mud will certainly anger people, or incite them to real violence. It is therefore not at all surprising that the "torture" of norns or the wanton destruction of avatars and virtual characters is considered unacceptable behavior under some circumstances. It may well turn out to be irrelevant if virtual life is exactly equivalent to *life*. If people will campaign "save the sea-monkeys" and "save the norns" with vigour, it looks as though our moral and ethical standards are coming into play for virtual life as well as simple forms of real life, regardless of the other distinctions we may wish to make between them.

6.0 Robot Pets, Soccer Players and Gladiators.

Kusahara explains that in Japan, the best known commercially available robot pet, Sony's *Aibo*, is treated in all seriousness as a legitimate artificial companion [6]. Personal

[2] There is a documented legal case involving a child suicide which the parent believes was caused by an event in the *Everquest* game world. In addition, there have also been documented legal cases between Sony/Verant and game players who have tried to profit from their time spent playing *Everquest* by selling virtual characters and game artifacts on eBay. I bring these cases to the reader's attention lest I be taken to task for inventing hypothetical situations which are seen as ridiculous.

communication with Japanese friends has tended to support this claim, despite its apparent outlandishness to Western ears. Perhaps further surprising to a Westerner, the level of acceptance seems especially high for *elderly* people. The *Aibo* robots are sophisticated imitation dogs and cats and consequently fall outside the price range of the majority of children (and this author). Although as a unit the robots and their less sophisticated cousins such as SilverLit electronics' *iCybie* resemble their flesh and bone brethren, it is not clear to what extent the internal workings are based around artificial life principles most researchers in the field would recognize as "their own".

One thing to note about *Aibo* in light of the discussions in section 2.0, the robots are surfaced with plastic, not artificial fur. Although the makers of other toys such as Axlon's *Petsters* of the mid-eighties, resorted to furring their pets, the Sony devices are so sophisticated in their behavior that even their hi-tech robot shell does not disguise (nor detract from) the sense of animation they convey. Perhaps the high degree of acceptance of digital technology in Japan also has much to do with the Sony designers' decisions.

The *Aibo* Open-R (*Aibo* application programmer's interface) bulletin board for developers is filled with banter about wireless networks, bandwidth, computer vision, joint angle controllers and so forth, but little of relevance to those of us interested in self-organization, self-assembly, or even mimicry of real living systems. As with the toys above, it seems that although the appearance and behavior of animals are important considerations in the design of the toy, at this stage in our technological development, we depend on traditional engineering paradigms to build devices which mimic life as we wish.

Despite the paradigms upon which their architecture is based, teams of *Aibo* have been programmed to play against one another in the international RoboCup soccer tournaments. Arguably this is an endeavor which aims to imitate the team behavior of (human) living systems as well as the ball-handling skills of individuals. Experimentation of this kind relates closely to artificial life research interests in self-organization and group behavior. The RoboCup web site states their goal, "By the year 2050, develop a team of fully autonomous humanoid robots that can win against the human world soccer champion team" [8]. There are shades here of Vaucanson's mechanical musicians. Whilst *Aibo* is involved in the current competitions, the organizers of these events hope that eventually humanoid creations will surpass us at sport, as Vaucanson hoped of his own androids in the musical arena.

In the case of *RobotWars* a thrill is induced in humans forced to consider their own fragility compared to that of machines battling in an arena and also through watching the destruction of something other than themselves [9]. This thrill seems similar to that aroused whilst

watching a gladiator fight a lion or a bull-fighter his own quarry.

There is no doubt that machines can be stronger and faster than humans. The interest therefore lies in the ability of humans to conceive machines with intelligence and co-ordination to match our own, not in the ability of steel to surpass bone or gears to surpass muscles. Hence the requirement above that the robot soccer team must beat us on our own terms is an *interesting* one.

The soccer rules are set by humans, the robot limbs must mimic human limbs. The interest to engineers lies in the difficulty of the problem domain — it is far from a trivial task to set in motion an android which can play within the strict constraints laid down by the RoboCup organization. For the same reasons, it is somewhat less interesting to contemplate the outcome of placing a human in an environment suited to robots (or into an arena suited to lions for that matter) without allowing recourse to the unique traits we possess which enable us to level the playing field.

In contrast to Sony's marketing links between *Aibo* and artificial intelligence, Hasbro takes an approach to marketing which borrows instead from biology and artificial life. Their toy *Biomechanical Integrated Organisms* (*BIO Bugs* for short) are designed to facilitate hacking, re-construction and modification, so that owners will further the "evolution" (sic) of their robots beyond the capability of organic beetles. Such ideas are also reminiscent of those behind the popular Lego *Mindstorms* marketed with the catch-cry, "Create robots you can bring to life and control".

To return briefly to the essay by Baudelaire mentioned above, he notes, "The overriding desire of most children is to get at and see the soul of their toys, some at the end of a certain period of use, others *straightaway*… The child twists and turns his toy, scratches it, bumps it against walls, throws it on the ground. From time to time he makes it restart its mechanical motions, sometimes in the opposite direction. Its marvelous life comes to a stop… at last he opens it up, he is stronger. *But where is the soul?*" (Baudelaire's emphasis) [3]. It is apparent that in Baudelaire's time, as now, people have enjoyed opening and modifying complex machines. By manufacturing *Aibo*, the *BIO-Bug* and Lego *Mindstorms* in such a way as to promote hacking, Sony, Hasbro and Lego are appealing to the engineer in the male target demographic. The toys then become subject to experiments conducted by backyard roboticists who rebuild them within their abilities, or destroy them completely.

Out of the box, *BIO-bugs* can apparently learn to communicate and propel themselves around a space. They may be trained by human users as well as through interactions with the environment and each other. These capabilities are facilitated by touch-activated sensors and

mechanical effectors as well as by infra-red emitters and sensors. The creatures may also emit audible squeaks and bleeps for communication with humans. The extent to which the advertising material for these robots reflects the reality is not known to this author. What is clear is that despite the many avenues which could be explored with these robots, their marketing campaign focused on their ability to fight. As with the *Nano-Fighting Pets*, RobotWars, the *EverQuest* characters and the tortured norns, the themes of giving and taking life, of diverting it to our own ends are ever present. The thought of Frankenstein's monster living a life of its own *beyond* the control of its creator, the idea of artificial life set *free*, remains as frightening to us now as in the past.

7.0 Conclusion

In the limited space available a survey of mechanical, electronic and composite toys of various types has been made, largely according to the whim of the author. No doubt every reader has in mind a particular toy which might also have been discussed in this article. The traits toys seemingly exhibit which allow us to identify them as life-like vary from device to device. They include mimicry, simulation (or in some cases instantiation) of various aspects of living systems, among them the ability to breathe, write, think, play music, reproduce, fight, crawl, eat, respond to their environment, grow, die, dance, demand attention and a host of others. What remains open is the degree to which each of these traits is purely metaphoric.

Even if all of these behaviors are only metaphorically possessed by the toys, we have shown the level to which our response to biological organisms is determined by our intuition, since it is to this which toy makers have applied their deceptions. Although our perceptions of animation in artifacts frequently contradict our intellectual understanding of biology, we are easily led "astray". Is this a bad thing? Toy makers and some artists depend on this characteristic for their success. Furthermore, if designers can create machines which are intuitive to use they also consider themselves successful. Hence, an understanding of the way we interact with living things may be of benefit, not only to toy makers and artists, but to industrial designers as well.

Perhaps in the future, we may have garden sprinklers which we "frighten" out of the way as we travel to the back shed, mobile cameras on legs which record family events based on their own "interest", or scarecrows which actively chase birds from the fields. Surely there are many devices which would benefit from a dose of life-likeness in keeping with our current level of technological innovation? Perhaps instead, a real test of our engineering skill is to match our own sense of *intuition* with that of a machine, rather than to reconstruct the planned and logical thought we claim to be our most valuable asset.

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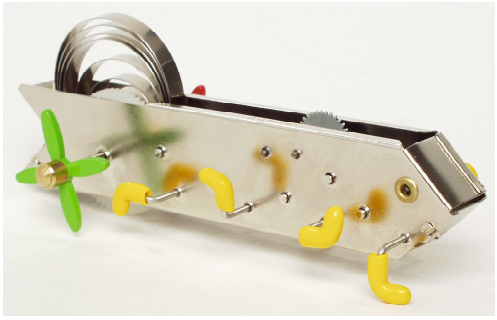

Figure 1. The wind-up *Bonga*.

Figure 2. Toy snake of hinged, cylindrical sections.

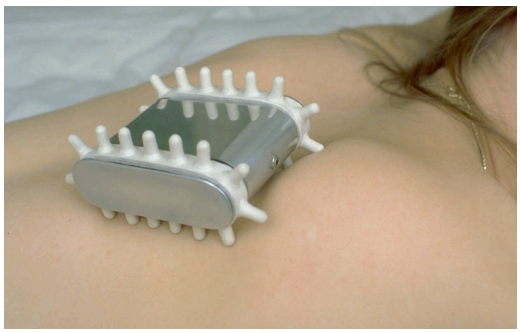

Figure 3. The autonomous *Tickle*.

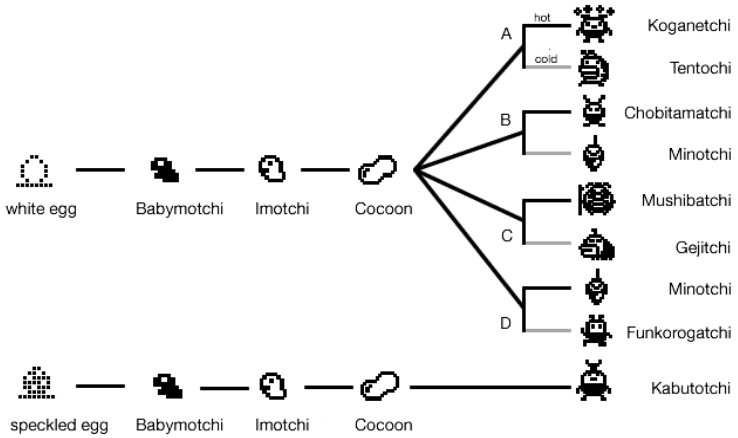

Figure 4. Mori-no Tamagotchi (Forest Tamagotchi) developmental chart (after [8]). The creature starts as an egg on the pixel display. If it is looked after by its human owner it progresses to a cocoon. From there, depending on the "temperature" set by the human, the different types of cocoon develop into various mature adult creatures.

Figure 5. *Bitman* at rest. From Ryota Kuwakubo / Maywa Denki art group.

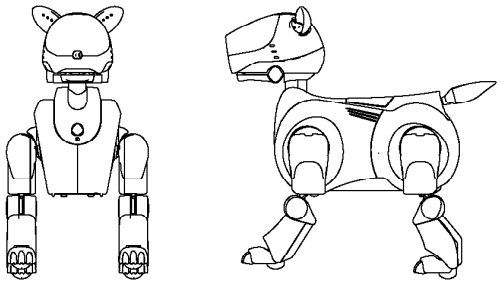

Figure 6. *Aibo* schematic. [11]