Synthetic Sentience on Demand

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Abstract

Without question, there is a state of change at hand, the rate of which itself is an acceleration vector never before experienced in all of known recorded human history. The contextual relationships between rapidly evolving technologies, ever expanding volumes and complexities of information resources, and socio-economic systems which are being spawned from a domain which I refer to as the "virtual terraform", are going to reshape almost every aspect of life as it is currently understood to be.

To study the nuances and implications of this synergistic codependancy process is to empower oneself to become an adaptable entity, capable of evolving, and utilizing the maximum potential functionality of the tools embedded into what is becoming an interactive, bidirectional experiencial conveyance system, which can be referred to as the "media matrix".

In that context, at the very top of the list, is the advent of synthetic sentience as a strategic resource, the internet system itself functioning as an evolvable system, and the deployment of advanced autonomous agent systems and "synthetic environments" populated with virtual communities of agent entities which utilize GP (genetic programming), neural net and related processes, and forms of process dynamics which instigate and foster the enterprise of inter-agent communications, conditionalized knowledge engineering, and "spawnable" process modalities which enhance (or even exceed) human capacity for decision rendering for mission critical applications. In essense, it is my belief (as well as a growing number of other participants in this arena of development) that knowledge velocity, scale, and complexity are rapidly exceeding human capacity for effective decision rendering under duress, in ever shorter time cycle increments.

Compression in decision boundary temporal domains is tracking directly with compression in functionality (complexity and scale) domains, thus placing a rapidly accelerating "pressure topology" on the surface of the "process dynamic manifold" from which policy, and strategic decision rendering can be evoked, as a process. The future I had speculated upon even just a few short years ago is already coming to life. Knowledge itself is even being compressed into shorter useful lifetime cycle windows. We are rapidly entering into a realm where decision rendering, as a mission critical process, will will simply exceed human capacity. At the threshold of crossing that event horizon, the ability to have access to the virtual terraform, populated with a potentially infinite number of intelligent agents and sentient entities, will no longer be an interesting luxury. It will become an absolute requirement.

Synthetic Sentience as an Engineerable Process

Synthetic sentience, as an engineerable process, is rapidly emmerging from the obscure realms of academic interest, or a narrowly defined range of industrial and military applications, and becoming translated into a

viable, commercial commodity. Indeed, numerous projects currently exist, in various stages of development which are specifically engineered as "synthetic sentience" engines.

Concepts which were once considered to be strictly confined to the wispy realms of science fiction are being translated into functional hardware and software components, which in turn are destined to become the "organistic subcomponents" of the global internet organism. Demonstrated at the world's first Virtual Humans Conference, held in Los Angeles, the equivilant of emotional sentience displayed as a process. Actually, the majority of demonstrations offered by various vendors were much more in the realm of physical human modelling, interactive biokinetics, and the tools for creating the 3D interface environments that these "virtual humans" would reside in.

Two notable examples were offered which shed light on the more compelling artificial intelligence components which could truly bring the virtual humans "to life". Offering an asthetically appealing, and functionally "correct" human form is, of course, the primary initial attraction "event" in the enterprise of luring real human participation in a synthetic environment.

The quality of emotional interaction, however, is the stimulus which instigates a continued commitment to participation. To this end, the work demonstrated by Professor Daniel Thalmann, of the Swiss Federal Institute of Technology, clearly indicated the direction this pursuit is aimed at. In his "virtual garden" example, a fully rendered, realtime synthetic environment, populated by approximately 20 humans, both male and female, would encounter each other at seemingly random intervals of activity. If any two or more of these entities would approach each other to within a certain virtual "personal proximity" range, they would then attempt to communicate as an emotional event stimulus. If the results of the communication were "friendly", they would touch, walk around together, and essentially behave as "real" humans might in an emotionally interesting chance encounter.

That the synthetic environment was on such a scale, populated with that many humans interacting simultaneously, represented an impressive level of computational complexity. Even the asthetics of the humans, and their environment settings was enough to be genuinely engaging to witness. The other example of this type of work demonstrated, which was on an even larger "scale" of behavioral complexity and quasi-sentience, was that offered by Professor Paul Rosenbloom, from the University of Southern California. As he describes his efforts to develop "synthetic digital societies", he points out that his mission is to "create virtual minds with a unified theory of human cognition". He went on to describe his applied theories and processes, in which "neural net self learning behavioral and emotional modelling with synthetic human avatars" is the primary goal of his efforts. His development efforts have been primarily financed by military agencies, with particular emphasis in very large scale synthetic environment simulations of various battle field sites populated by an array of synthetic humans operating as opposing teams of "agent entities".

There is a significant point here, however. By the very nature of the conference participation, and by the published statement of its organizer, Dr. Sandra Helsel, this technology is being seen as the components for the next form of interactive emotionally ergonomic communication, virtual theater environments, intelligent "malls", and a myriad of other applications which will become commercially viable in the near future. As the editor of VR News, a leading trade journal representing the academic and commercial development of virtual reality applications, she offered this commentary to describe the significance of this event : "Two powerful forces are combining to open up the Virtual Humans marketplace. The first is the accelerating and tangible market interest now evident in all forms of Virtual Reality. The hype and the hope are at last giving way to solid commercial activity. Right across the board, from commercial training to entertainment systems, and from virtual engineering to heritage reconstructions, the market is maturing and growing, and multi-million dollar contract awards are no longer a rarity. The second, inevitably, is the Internet.

Around a half-dozen on-line 3D communities are up and running, complete with their first-generation avatars. In a few years time there will be hundreds, and then thousands - social, cultural, commercial meeting places, visited daily by millions of people. What is crystal clear is that these virtual environments need to have virtual people in them. On-line social and games communities are designed specifically for that purpose. Virtual cars, aircraft, houses, retail stores and factories are not just for looking at - they will be used by real people when they are built, and they too need virtual humans, to check out their accessibility and convenience, maintainability and safety.

Virtual shopping malls will have sales 'bots ; historical reconstructions will have guides, sometimes taking the form of contemporary inhabitants; virtual fashion shows will have mannequins; virtual learning environments will have virtual teachers, demonstrators, and difficult customers. Until recently, there was no virtual humans marketplace to speak of : just a few pioneering research groups - notably Prof. Badler's team at the University of Pennsylvania, and the Thalmanns in Switzerland - a handful of products, and a few significant projects each year. There is now an unmistakeable undercurrent of change, and of new interest. The leading VR software companies are building or licensing human modeling extensions; performance animation is becoming commonplace at marketing events, and is moving strongly into the TV and virtual studio field; standards discussions are under way in relation to humanoids for ergonomic testing".

Synthetic Sentience as a Strategic Resource

In the realm of commercial agenting systems and protocols, quite a variety of options are available, both for the private and corporate user. The deployment of intelligent, interactive autonomous agents as a self functioning, dynamic system, accessable as a "resource node" on the internet extends far beyond general consumer applications. The examples cited above are only a very minimal suggestion to the totality of intelligent agent populations which are spreading rapidly throughout the realm of the "virtual terraform".

No longer merely a pasttime for the web hobbyist, an academic researcher, or even the tentative experimentation of a growing business enterprise, reliance upon knowledge engineering, as a deliverable commodity, is rapidly becoming a requirement for competitive survival. Indeed, a threshold will soon occur when the for strategic agent deployment will become an absolute, rather than an option, for commercial viability in a competitive marketplace. Decision rendering under duress is a process which has been studied in great detail, particularly in very large scale synthetic environment simulations developed for the military.

Sentience, as definable in part by the "awareness" of one's self, can in some cases be measured by the defensive posturing and maneuvoring that a "synthetic entity" will employ on its own behalf. In the arena of defensive reasoning and response activity interactions, the quality or "robustness" of the behavior can be judged not only by how well did the entity in question "survive" the implied threat or "trauma event" of the moment, but also, how effectively did it learn to adapt, and therefore "improve" its response to the next perceived threat event. To the extent that this type of defensive behavior can be codified into a functioning, evolvable, even predatory entity, has recently been deployed beyond merely the realms of academic research, or even military applications development.

In a market environment where the new currency is time, and commodity of highest value is the aquisition of conditionalized knowledge and its immediate application, there is little if any margin for error or misjudgement. Increased dependancy on not only "engineered knowledge", but also on synthetically enhanced reasoning and deduction, will become a strategic imperative to almost all functioning business operations. The synergistic combination of this new market environment, the drastic increase in "internet connectivity", and the

technologies which are about to become available as "modular components" embedded in this massive connectivity grid is the socio-economic breeding ground for this newly emmerging "synthetic sentience" based product line. These are the precursory ingrediants for spawning an environment in which the global internet system begins to take on "organic" properties.

Self modifying, self organizing, "hyper switch" networks, routing the "activity stream" events of advanced artifical intelligence driven agent entities, which in turn generate synthetically driven "decision rendering" processes, are all properties that one could assign to a macro system "pseudo organism". This model is futher enhanced by the continued dependance, by the human population, on the "health" of the organism, i.e., the internet system and its "organic" features, to provide the very essence of life in terms of business, work, education, and entertainment.

It is a telling indicator of the cultural norm of a techno-industrial society, such as that prevalent in the major cities of Japan, that the creation of such artificial lifeform "entertainment" content would be accepted, and even desired as a practical alternative to "real" lifeforms as personal companions. Synthetic sentience, as an engineerable process, is rapidly emerging from the obscure realms of academic interest, or a narrowly defined range of industrial and military applications, and becoming translated into a viable, commercial commodity. Indeed, numerous projects currently exist, in various stages of development which are specifically engineered as "synthetic sentience" engines. Concepts which were once considered to be strictly confined to the wispy realms of science fiction are being translated into functional hardware and software components, which in turn are destined to become the "organistic subcomponents" of the global Internet organism.

The pace of advanced artificial intelligence oriented development was initially being driven by the market forces of knowledge engineering being viewed as a commodity resource base for both private and commercial use. An outgrowth of this development stream, however, is about to become the new "entertainment commodity" of the near future. Sentience on demand, as a "purchasable" online resource, has more to offer than merely finding information, and providing synthetically driven decision rendering as a process. It also has the potential for providing immersive environment "experiences", populated with synthetic personalities, possessing the defacto equivalent of "emotional sentience", as a rentable "event" for the user.

Sound far fetched ? Perhaps, for the "uninitiated". It is certainly true that in the past there were many attempts to "spawn" artificial intelligence as a process. These earlier attempts were often eventually thwarted by computing power resource limitations, logical lexicon structures that were yet not developed to support such processes, and "rules based" languaging protocols that proved to be limited in the scope of their "organic" process modeling.

It was also at a time when the marketability of such a capability was seen as being confined to a relatively narrow, if not "esoteric" range of applications. This form of technology was not seen as a generally attractive "investment" in terms of commercial viability. But now, as the Internet has been "primed" to become the ubiquitous, universally accepted environment for business, information resource access, education, and entertainment content, the market share potential is extra-ordinarily alluring.

Agents on demand, today

Although still only being commercially deployed on a somewhat limited scale, agents, and multi-agent environments are beginning to flourish on the Internet. A good example of this process occurring is the Agents Inc. FireFly website. Here, the interested user can log in, answer a collection of questions designed to provide an "agent" with enough personal information to establish a demographic model, and then over time be presented with various entertainment product items that it believes its human counterpart might be interested in. This

example is only a very limited suggestion of what will soon become available as "commercial agenting" as a general process.

Imana, with their Talisman product line, is another current example of this agenting process being applied as a "consumer" service. As they describe it, "Imana is the creator of Talisman, an advanced framework for cooperative agent and information discovery systems. Talisman enables a new generation of products and services to offer personalized information delivery, targeted advertising, and self-forming online communities".

Imana's foundation is the Talisman & trade cooperative agent technology. Talisman agents discover relevant information and resources guided by the preferences of each individual. They succeed by sharing their information with other agents, cooperating to make new discoveries.

The next step, into the World of OZ

What was just described in the previous section consisted of some of the first commercial applications offering online access to "intelligent agent" technologies for the average consumer participant. The next step of development is to offer Internet access to three dimensional, interactive environment realms populated with "intelligent avatar" entities, and related dynamic components as a "commercial" product. As the creators of "OZ Virtual", OZ Interactive, inc. describe it, "welcome to the next dimension in social computing". This current example of this type of application service provider offers access to an online Internet server, and development custom of VRML interactive environments, including customized avatar and "intelligent angel" entities.
The intelligent angel entity concept is particularly interesting in this regard. "Users can have access to an elaborate help service represented by a personal agent called the Angel. The angel can be summoned at any time by the user and appears as a three dimensional angel. This angel can then be asked questions in plain written English, and its answers are translated to speech, using the latest text-to-speech technology".

Synthetic sentience as a strategic resource

The deployment of intelligent, interactive autonomous agents as a self functioning, dynamic system, accessible as a "resource node" on the Internet extends far beyond general consumer applications. Competitive, even "predatory" knowledge manipulation and engineering, as a process, is being seen as a strategic resource. In a business environment driven by an ever increasing dependency for near realtime information access, and intelligent processing, this type of a "virtual" resource base becomes as strategically important as any other assets a business can include in its "arsenal" of available resources. Indeed, a threshold will soon occur when the requirement for strategic agent deployment will become an absolute, rather than an option, for commercial viability in a competitive marketplace.

The synergistic combination of this new market environment, the drastic increase in "Internet connectivity", and the technologies which are about to become available as "modular components" embedded in this massive connectivity grid is the socio-economic breeding ground for this newly emerging "synthetic sentience" based product line. These are the precursory ingredients for spawning an environment in which the global Internet system begins to take on "organic" properties. Self modifying, self organizing, "hyper switch" networks, routing the "activity stream" events of advanced artificial intelligence driven agent entities, which in turn generate synthetically driven "decision rendering" processes, are all properties that one could assign to a macro system

"pseudo organism".

This model is further enhanced by the continued dependence, by the human population, on the "health" of the organism, i.e., the Internet system and its "organic" features, to provide the very essence of life in terms of business, work, education, and entertainment.

The Internet as an Organism

An organism can be defined as "anything resembling a living thing in its complexity of structure or function". Considering the exponential growth of the global Internet, the increasing complexity of connectivity systems, self-modifying code structures that can be "trained" to search for contextually linked data, information processing on a scale that rivals many living organisms, and the potential for a "sentience threshold" factor, is there an argument for observing the global net as a quasi-organic process? Is there a point soon to be reached where humans that tap into the net are like the input stimulus sites of synaptical fibers of a planetary network of ganglionic clusters? This is no attempt to determine a qualitative judgment, but rather to explore the concept of a global entity that possesses organism-like properties.

Of its own accord, growing at a rapidly accelerating pace, this organism may eventually "evolve" to a status of truly symbiotic interactivity. In nature, symbiosis is the co-existence of two dissimilar organisms in close proximity to each other, particularly when such a union is advantageous to both, as in the case of the fungus and algae that together form a lichen. If one were to consider that the global Internet has already crossed the "functional complexity" status of either one of those components (the organic properties of an algae or a fungus), then a symbiotic model can already be said to exist. The planet's human population, in an ever more global society, becomes ever more dependent on the net to provide near-realtime access to almost all information; it becomes something of the "bloodstream" of that population.

The aesthetics of engagement, and the reward for participation

Given this scenario, the Internet access experience will become as transparent to the average user as turning on the TV for viewing a program. But instead of "viewing" a program, the user will become immersed into a bi-directional "entertainment experience".

The appeal for much of the TV viewing public today is the opportunity to engage in a temporary, vicarious fantasy experience as they "interact" with the character(s) they identify with on their favorite sitcom series, "soap opera", or whatever. However, as a cultural norm, the desire for attaining a satisfactory "entertainment fulfillment" event will become ever more demanding.

Against this backdrop of mono-directional broadcast media, has also emerged the first layers of interactive entertainment content. Until recently, however, the majority of interactive content development has focused almost exclusively on competitive, militaristic themes where the interface into the environment was very biokinetically dependent, and the reward for participation was measured by the successful vanquishing of an enemy or predatory opponent.

By extreme contrast, the next layer of interactive entertainment "synthetic environments" are being produced to present the human participant with the reward of participation being the emotional engagement of various

characters, and the various forms they "evolve" into. In these new realms, biokinetic interfacing is almost arbitrary to the depth and quality of interaction. This desire for more engaging, vicarious interaction with the character sets and "virtual situations" of interest will no longer be satisfied by merely viewing such a fantasy realm. It is at this "threshold of desire" that a new industry will emerge to satisfy this demand.

This new industry will be engaged in the enterprise of supplying immersive synthetic environments, populated with user definable, emotionally sentient "synthetic personality" characters, object oriented modular scene components, personality attributes, and related artifacts of applied artificial intelligence based "entertainment" content. In other words, the defacto equivalent of sentience on demand, as a commodity.

In other words, a self modifying branching structure, re-organizing its interconnectivity geometries as an adaptive process. As an organistic macro structure, the system "learns" to optimize its connectivity to the human population embedded in the "tissue" of its structure. The question could be asked, is this the beginning of an organism behavioral state? Does this represent a human/Internet symbiosis of an organic nature ?

These are the very types of interdependency characteristics that most symbiotic relationships are identified by. In order to further illustrate the premise of the global Internet as an organism, one would still need to establish a complexity model, a capacity for self instigated growth factor potential. Even if that growth factor is dependent (at least for now) on direct human interaction and connectivity, a modality for self modification driven by human spawned activity "patterns" is the model for the eventual evolution of a global scale collective form of sentience.

The degree to which the human population is immersed in this symbiosis will be measured by the extent that the artifacts of culture, processes of expression, entertainment and recreation, i.e., the very essence of human identity-becomes dependent on the global Internet system.

Rentable Organisms, Avatars on Loan, Disposable Personality Entities

There is a stage of development in the foreseeable future where the concept of "rentable organisms", with root personality attribute traits will become a marketable commodity. A collection of ready made, available avatars could be accessible as temporary entities, to which user specific personality artifacts could be attached as dynamic component objects. In this realm, the human user is presented with the resource of disposable, reusable personality entities as avatar extensions. Entire catalogs of personality trait feature sets would become part of the "product line" of online synthetic environments.

There will indeed be a demand, even a requirement in this newly emerging world (both virtual and real) for libraries of "character entities" with various forms of "strategic functionality" embedded in the logical lexicon of their personality construct. Strategic deployment of "sentience on demand" will likely extend far beyond the perimeters of "entertainment" or recreation, and no doubt become a serious component in the competitive arena of knowledge engineering and data miming. Much of the business world of today relies specifically on the "quality" of the information base it can research, and extract meaningful content from, as its primary "weapon" in maintaining a competitive edge. Without question, the ability to construct, and deploy "rentable" research agents with quasi-sentient properties to "ply the waters" of the global information data base will be viewed as a strategic resource.

Access to such "sentience on demand" itself will become a major business, with an entire infrastructure evolving around this provider service. In its eventual implementation, the precursory elements of an object oriented personality constructor system, which allows for the implementation of user definable "synthetic

personality" entities in a dynamic, interactive immersive environment, will be as "common" as the various Internet related services are today.. These "character entities" will actually possess the defacto equivalent of emotional sentience, and are designed (as the interactive audio/visual artifacts of self modifying/self organizing code structures) with xenomorphic personality attributes.

The artificial intelligence developments that much of the public has seen evidence of from the "distant" past is nothing even remotely comparable to the current genre of this domain. More recently, forays into this theoretical realm are rapidly being translated into functional "systems" (both hardware and software) that can provide this type of "synthetic sentience" as an avatar based, virtual environment "entertainment" application.

Sensory Seduction as an Engineered Process, the Invocation of Rapture as an Event Cue

Nature is designed to be seductive, and thereby implicitly interactive. Form, shape, color, composition, as they occur in the natural world, are "engineered" to be as alluring as possible, to solicit the attention of the observer. This is not an accident. The shape and color of a flower, the structural composition of a landscape, even the ethereal kinetics of a field of grass billowing in the wind, all have alluring aesthetic content. In many cases, the purpose of the design is relatively apparent, as a practical means to an end. To possess aesthetic content is to attract a desire for engagement with a process, object, or event. From a macro systematic perspective, the collective "attractiveness" of an entire environment in the natural world is to provide an avenue for its protection and preservation. The human population, which possesses the singular ability to destroy an entire environment at will, can be compelled not to embark on such a destructive path if sufficiently inspired by the aesthetic "beauty" inherent in that environment.

The seductive potential of an environment should not be underestimated. The degree to which rapture can be invoked, as a process, is a measure of the effectiveness of the environment. As a mechanism for sustained interaction within the environment, even to the extent that leaving the environment represents a "sacrifice" on the part of the human participant in the environment, aesthetic cue features have as much importance as the virtual organisms that may be resident in the environment.

In a world where the human population is "seduced" into surrendering its connection to the real world, and is enticed to "opt out" of the natural surrounding environment, the hunger, indeed the requirement, for ever more engaging synthetic environment interaction will no longer represent a voluntary, recreational event. The paradigm of stimulation, pursuit of aesthetic content, and interaction with sentient beings, will transition, at least in part, further away from the "real world", and into the purchasable commodity of the "synthetic world. This is the beginning edge, the metaphorical threshold point of a synergistic co-dependence between the Internet, where access to the synthetic world is available, and the human population that is drawn to it for interactive stimulation.

This is a challenge, perhaps even a perceived threat to the cultural norms that most people understand today. But this realm is also a source for spectacular potential in aesthetic content development in the virtual environments of the near future.

In essence, the range of forms and structures available in the nature of the real world, even in the most prolific rain forests, oceanscapes, geological terraforms, and so on, are a "fixed" value. There is a finite limit to the known range of available realms, and their respective content, here in the real world. This limitation disappears in the virtual world.

Though this may seem to be a tentative argument at this moment in time, I submit that in the future, the "commodity" of exploration of infinite varieties of aesthetically compelling synthetic environments will in itself

represent a behavioral transition in entertainment events. Virtual terraforms, ecosystems, and "environment sets" could indeed be as compelling as the pseudo-personality entities that may, as a selectable option, be resident in these virtual worlds.

Intelligent Agents as a Mechanism for Ergonomic Enhancement of Interactive Environments, and Demographic Data Extraction

With the rapid emergence of electronic multimedia as an environment conducive to providing access to products and services, the concept of "agents", which has been in existence for years, is evolving into a new concept, "intelligent agents", as a mechanism for ergonomically enhancing the interactive experience of the user of such media. Also, and perhaps of greater importance to the creators of these "media environments", is the bi-directional data stream generated by the interactive usage of these environments by an ever increasing, and diverse user base.

This process provides demographics data feedback output which symbolically represents the activities, reaction patterns, and behavioral attributes of the human user in response to whatever event cues are provided in the media environment. As a dynamic process, this has the obvious potential of generating a demographics data base that help the designers of these environments create more compelling, and seductive content an "entertainment" event. However, an even greater potential exists to actually utilize this output feedback data stream as the dynamic input stimulus to influence the behavior and "evolution" of synthetic organisms, and their synthetic "personality" attributes.

From the Early Creation of Agents, to the Evolution of Intelligent Avatars The development of agents, as a design and implementation process, could be viewed as the enabling technology leading to the next level of operational complexity and functionality, the "avatar". The concept of agents in general stems from the early days of attempting to create intelligent, automated mechanisms for contextually searching large scale data bases. Commonly referred to as "agents" or "intelligent agents", the range of functionality, methods of deployment, and complexity of task handling as an agenting process vary widely.

Interestingly, the more sophisticated and complex the code construction of the agent internally, the more "approximate", or fault tolerant, a definition of desired content can be invoked to actually initiate (and successfully complete) the search. The ability to approximate values, or determine a "truth proximity" threshold as a test for recognizing a valid data set as a search process, is the beginning edge of intelligence features designed into an agent entity. Some early versions of these intelligent agents often employed various versions of so-called "fuzzy logic" as a programming mechanism for creating the agent. Fuzzy logic, as a logical lexicon, is specifically designed to respond to approximations, and relative "nearness" of values, rather than respond only to absolute values, which is the case for more traditional programming languages and logic structures.

The most sophisticated of all modalities of search engine types are those which can "learn" on their own from repeated input stimulus, and therefore develop an affinity factor for a particular range, or approximation, of a content type. Such intelligent agents often rely upon self modifying and self organizing code structures, which can in turn compose their own search criteria "on the fly" as a dynamic process.

They continue to explain that their effort is to "model coalition formation where agents form coalitions for breaking deadlocks". This process is referred to as Distributed Constraint Satisfaction, and is intended to allow agents to resolve problems which they may encounter while negotiating a group task.

These types of agent components tend to utilize neural net like features, and often adopt behavioral

characteristics that resemble the activities of an artificial organism. The development of such agenting systems, based on artificial intelligence behavioral attributes utilizing quasi-organic, neural net-like feature sets, can be viewed as the enabling technology leading towards the next increment of agent entity development, the "avatar".

The avatars of today, for the most part, are not designed to independent, self modifying entities which yield the virtual equivalence of "sentience" as a behavioral attribute. This is not to say, however, that this is not possible. It is from this initial inception of "agent construction" as a process, and various related hybrids, that the precursors of "synthetic personality" entities become apparent.

Xenomorphic Avatars as Virtual Character Entities

An important design feature, in the development and "evolution" of an intelligent avatar, is the inherent ability to directly influence, and effect the dynamic "reconstruction" of an avatar entity. As an interactive process, this process renders a continuously evolving "virtual character" entity. By definition, a "xenomorph" is an entity which can reconstruct itself to effectively respond to a perceived trauma event, an opportunity for gain, or change of conditional feature sets within an environment, in order to optimally adapt to the circumstance at hand. In that sense, an entity possessing this attribute could be viewed as a near realtime "adaptor engine". In the realms of xenomorphic personality adaptor engine design, the concept is to construct a "personality organism" which has a core entity with a specific range of behavioral attribute feature sets, around which would be a series of adaptor feature set interface portals. Somewhat like the concentric rings of an onion, or more accurately, as concentric spheres representing layers of complexity, a collection of behavioral feature sets can be attached and rearranged in ascending layers of complexity/functionality to create the complete organism.

A Simple Model of an Organelle Component Hierarchy, and Complexity Layering as Would Apply to the Construction of a Synthetic Organism Xenomorph

The organistic subcomponents, as feature set attribute "objects", have a range of interconnectability and exchangeability within the classification of their species type, and layer of complexity they are designed to correspond with. This is the framework of a clustering model, as it is often referred to in "traditional" neural net-like structures. For the sake of definition in this particular description of synthetic personality generating adaptor engines, these organistic subcomponent "clusters" will be referred to as "organelles".

Included here is a brief statement which describes a theoretical hierarchical model for a dynamic, self assembling, self organizing, xenomorph component system. The components, and their subsequent clustering and macro-clustering formations, form the criteria of an ascending layer of complexity protocol.

Cross compatibility of species types within a given complexity layer can remain relatively constant to within a certain range of functionality "descriptors". A group of macro cluster objects, consisting of an aggregate population of specific species types, can in turn organize into "super" macro clusters, and thereby ascend into the next layer of complexity status.

At this level of complexity, the "super macro cluster" object begins to assume the attributes of an organ within a complete organism, hence an "organelle". Now, the degree of cross compatibility of different organelle types is confined to a relatively narrow range of specialization, and attribute features.

As a personality constructor process engine, the arrangement of the organelle components, at the "outermost" spherical layer of complexity, forms the essence of the personality type. The numbers of complexity layers, and the diversity of functionality sets required to render a truly heuristic model of a synthetic personality "entity" is a matter of definition, and debate. The object here is to merely outline the protocol of a structural form, and logical lexicon, representing this process.

Self Evolving Personality Organelles : Virtual Emotion Constructors

A series of object-oriented personality components, or "organelles", which represent characteristic behavioral feature sets, can be re-arranged and interconnected to form a personality matrix specific to the user. The result is a structural template representing those features that are most likely to elicit a desirable response for the person constructing their "synthetic personality".

Personality attribute libraries of these organelle components would be available to a user who wishes to construct a "root personality" for their avatar, over which they would have initial total control. However, just as with evolutionary personality growth in humans, the emotional components of the personality would tend to generate their own nuanced predilections over time.

This is where the boundary of emotional sentience begins to form. The behaviors of an artificial personality would not be confined to those that were originally assigned to it. The human creator of the "virtual personality" would have a decreasing mantle of control over the behavior of the avatar-organism. Conversely, the organism develops increasing independence, perhaps ultimately even an awareness of "self" over a consistent series of self-modifying personality iterations.

The Need for Bi-Directional, Vicarious Existance Entities as an Experiencial Entertainment Medium

Would the potential for rebellion exist in this realm ? Perhaps this is the "fun threshold" of virtual environment adventure worlds. How much more stimulating a game, exploration environment, or interactive entertainment event would become if the personality attributes of the virtual characters, including your own, were independent, argumentative, and changed with experience. Is this not some of the "stuff of life" many individuals yearn for in their daily, physical world ? What if sentience could be "hired" on demand, as an avatar presence ?

People today live vicariously through the lives of characters on their favorite TV programs. This process takes place in a real world where human interaction is still common and continuous. However, as the degree of electronic bi-directional connectivity increases, and "physical co-existence" gives way ever more to "virtual co-existence", so will the desire for enhanced, vicarious entertainment event content.

Rentable Organisms, Avatars on Loan and Disposable Personalities : Emotional Sentience

as an Entertainment Commodity

It's at this stage of development that the concept of "rentable organisms", with root personality traits becomes a marketable commodity. A collection of ready-made avatars could be used as temporary entities, to which personality artifacts could be attached as dynamic component objects. The human user has a selection of disposable, reusable personality entities as avatar extensions.

Entire catalogs of personality trait feature sets would become part of the "product line" of online synthetic environments. This will become a key new entertainment commodity of the cyber realm. The complexity and richness of experience, not just in the activity aspects of synthetic environments, but even more so in the emotional richness of the avatar entities that we vicariously live with. What would people pay to have this entertainment ? Why "watch" a movie, when you can configure and live in it, with your own collection of self-evolving characters ?

So, how does this concept relate to an interactive, "recreational" experience for the user who wants to experiment with, or live vicariously through the experiences of their personal synthetic organism avatar ? Consider a realm in which your own personal synthetic organism possesses the ability to independently recognize, and interact with other pseudo-organisms that it encounters in the environment that you have decided to temporarily reside in. The "quality" of such interactions would depend in part on the cognitive threshold enhancement features that could be assigned to your organism. These feature sets are part of a menu of personality factor sets. The more complex and adaptive, the higher degree of computing resource is required to support, i.e., the higher the relative rental fee for access to these enhancements.

A community of such xenomorphs could draw upon a sufficiently large enough population of personality organelle and suborganelle component types to reconstruct and adapt themselves to continue to thrive, and perform enhanced predictive analysis of their volatile environment. This would serve as an observational mechanism for providing an output data stream indicating their behavioral reactions.

The behavioral reaction sets, and the patterns that these reactions may be correlated to, would serve as a vicarious window into this synthetic environment. The external observer of these reaction pattern sets could be, in a sense, allowed the privilege of peering into this synthetic environment, and "see" what is about to happen, or at least have an enhanced predictive analytical thread of cognition with which to base criteria for decision rendering.

It is this enhanced thread of cognition, driven by the predictive analysis characteristics of the self-adapting, self-organizing attributes of the xenomorphic organism entities flourishing in their synthetic environments, which provide a unique mechanism for adaptive, quasi-sentient behavioral interactivity. As an enabling technology for a new form of "entertainment", synthetic organisms comprise a very broad range of possible applications.

The "Virtual Shopping Mall" example

Outlined here is a brief functional description of a user-specific intelligent agent avatar constructor engine. The application describes an interactive "shopping experience" enhancement in dynamic, interactive virtual mall environments. In the realm of traditional retail outlets, the goal is to present to the visitor an aesthetic environment that displays the product in an inviting, stimulating and cost-effective manner. In a physical store, the environment is static; as such, the broadest possible common denominator of personality dependent stimulus/response attributes needs to be factored into the floor presentation of merchandise.

By contrast, in a dynamic, virtual mall synthetic environment, the aesthetics of presentation and the attributes of the interactive experience itself, are all dynamic variables that can be directly driven by "personality attributes" of a shopper's intelligent agent avatar. The intelligent agent avatar is an extension of the human shopper, projected into the virtual environment. As a representation of the shopper's personality traits, demographic features, aesthetic and/or emotional stimulus/response characteristics, the avatars's "personality matrix" dynamically "shape" their interaction with the array of event stimuli available in the synthetic environment.

Therefore, if a person enters a virtual world shopping experience via this medium, their interaction with the content would be dynamically customized to their unique properties as defined by their avatar representation. The end result is a dramatically variable, user-specific, unique experience for each shopper, emanating from a common product database/artificial environment.

An intelligent agent is essentially a search engine component that can independently query for and acquire data objects according to parameters established during the inception of the agent. A self-modifying agent, using neural net-like code as a kernel, would generate the properties inherent in personality attributes; aesthetic event cue stimuli/response elements. These factors would symbolically represent the "live" shopper. The shopper's experience in the virtual environment would then be driven by, and be uniquely specific to, the properties inherent in the agent-a virtual extension of the shopper.

A series of object-oriented personality components (or "organelles" in the organic metaphor) that represent characteristic feature sets, can be arranged and connected to form a basic personality matrix specific to the user. To build the personality, we need an initial input stimulus event, from which the first layer of response stimuli sets are extracted. It could be something as mundane as a form template. However, the process could be made much more compelling, more like entertainment. If such entertainment events were embedded in the initial "visit" to the virtual catalog/mall front end, one could generate much more robust demographic data to "custom tailor" the virtual mall to the individual visitor.

As the user responds favorably to some stimulus events, and less so to others, the end result is a "weighting factor" affinity template; a structural template representing those features most likely to elicit a positive response from the potential shopper. This then becomes the feedback loop to generate a second layer response stimuli set, which in turn becomes the back propagation data stream to "guide" the user into interactively structuring their avatar/intelligent agent entity.

The more cycles of interaction with this agent customization process, the more robust and user specific the agents' response stimulus characteristics become. Those response stimulus sets then become the template that shapes the hierarchy, presentation, and interactive feature sets of the product presentation event sequences about to be experienced by the user.

Virtual "Amusement Parks" in Cyberspace ?

Virtual entertainment, designed to enhance and customize the shopping experiences of online interactive product and services presentation, are the logical precursors to establishing the components for complete "amusementpark" environments in cyberspace. The shopping mall example cited above is merely a functional template for describing elements of what could constitute an almost infinite array of entertainment applications.

Synthetic, self-organizing, reconstructive environments are the obvious breeding grounds for immersive virtual theme parks. Furthermore, the range of aesthetic and interactive activities these environments can offer the

vicarious visitor is extended by the features of other "intelligent avatar" visitors with their quasi-organic behavioral attributes.

Self evolving "virtual terraforms" are envisioned in this model as the landscapes, terrains, and structures that can be visited and interacted with. In my vision of this model, the virtual terraforms themselves are as dynamic, and potentially organic in functionality as the avatar entities that visit them. The synthetic environment itself can become an integral part the entertainment content.

Knowledge Engineering as an Industry, and the Spawning of the "Next Generation" of Intelligent Avatars, Artificial Organisms

A trend is now emerging, where the sheer volume of information that could be perceived as being relevant, or even crucial, to the human participants seeking such information are beginning to rely upon automated, self modifying contextual "search engines". In other words, reliance on an artificial intelligence based, contextual search system is no longer an esoteric luxury. It has become a necessity.

As explained earlier, developmental evolution of so-called gobots and knowbots was the "primordial beginning" of artificial intelligence driven search engines. These were designed to be "trained" with a basic set of contextual parameters. Once "let loose" out into a network, they attempt to establish their own data streams and affinity factors to find whatever it happens to think might be interesting or relevant to its initial training "template".

A training template is not a rigid parameter set, with an absolute match requirement to satisfy a logical "yes" value when an exact word, name, or other identifier tag is found, but rather an approximation value that represents a logical "similar" value. The "relative similarity" value itself can be a dynamically modifiable feature set, so that a consecutively broader search context can be established, and redefined as the knowbot searches for, and finds, items to which it has established an affinity.

Subsequent artificial intelligence search engines were designed with neural net like process elements. In search operations invoked with these newly developed types of systems, every instance of a successful approximation match strengthens, or magnifies the robustness to which another example of a similar stimulus will be responded to.

In this way, such a process engine "learns" from its experiencial exposure, and in the process builds up its own content addressable memory region. In other words, the longer such an "entity" is allowed to reside at a node and actively scan all data streams or logon to access nodes looking for something it "wants", the better it gets at the process.

Hence, the business of developing ever more sophisticated data searching, contextual linking, and "intelligent" processing has become an industry in its own right. In fact, for many businesses, the ability to have access to "knowledge engineering", as a resource, is as crucial to its operation in a competitive environment. It is the evolutionary development of knowledge engineering tools and techniques that is now spawning the next generation of tools, and resource base, with which to begin to create the "intelligent avatars", synthetic personalities and organisms, and the virtual environments they reside in.

The interesting feature of this scenario is that as the total number of human users, volume of information content, and node sites continues to increase, a relative complexity threshold is being approached which already surpasses many "simple" organisms in connectivity and stimulus processing. This model is beginning to take on

the behavioral characteristics of higher level organic behavior.

This is exactly the symbiotic model found in organisms in nature, that is, the required, rather than optional, interdependency between the two (or more) components in a symbiotic system.

Human behavior, and interests, are in fact being shaped by the structure of the Internet. People are no longer limited by geographical constraints as the primary determinant feature in their activities or interests. The concept of residing in "cyberspace" as a daily activity, for leisure, social gatherings, political interest activities, education, etc., is considered "normal" everyday activities for a very rapidly increasing percentage of the human population. In a subtle, yet irreversible transition, the Internet is becoming embedded in almost every aspect of human activity. As the embedding process penetrates ever further into the strata of daily human activity, the resulting symbiosis is enhanced to a status of perceived requirement by its users.

Restructuring the "virtual terraforms" of earth's inhabitants is being driven by the ever increasing growth rate of the global connectivity grid. It is the synergistic codependency between the global Internet system, and the human population that symbiotically connects to it, that is at the very heart of this process.

The concept of "entertainment", a fundamental requirement for the well being of any person attempting to function in the existence matrix of daily life, will likely change as radically as the technical and socio-economic components of the new age at hand. It is in this arena that the Internet plays an extraordinarily central role, will begin to take on truly organistic behavioral attributes on a global scale, and drive the very essence of human behavior and motivations in the near future.

Interaction with other individuals may, or may not, necessarily require "real" organic contact, but rather the enhanced, sensory illusion of an experiential event stream. It is in this cyber resource base that the components of an individual's existence matrix will reside, and to which the authority of access and control are dispensed.

Experiential technologies, as they become accessible via the global connectivity grid, are in essence the interface components for creating its organic, symbiotic characteristics. The enabling technology processes spawned by the implementation of the global Internet system are rapidly converging into a new "existence matrix" which the human population will learn to adapt, and evolve into. At the heart of this realm is emerging an entirely different definition of what constitutes "entertainment", and by what mechanisms a sense of recreational and aesthetic fulfillment can be experienced.

"Virtual Entertainment" in a Virtual World

We're poised on the edge of an era in which traditional events and places that represent the cultural norm of the moment are about to be augmented or supplanted by the virtualized versions of their physical counterparts. Entertainment locations, ranging from shopping malls to movie theaters, the usual sites for the ritual of seeking entertainment, will have analogs in the digital environment.

Entertainment content need not be limited to merely observing or participating with a predetermined series of events. The entertainment "event stream" itself may have the potential of becoming an ever-self-modifying, reconstructive environment which spawns its own contents according to the activities of the human participants. Furthermore, on the Internet, the limitations of geographical and temporal constraint essentially disappear, which allows a consistently high "refresh rate" of these live contributions.

Adventures with Avatars, life in the AlphaWorld

Although the primary focus of this chapter is the development of synthetic sentience as a process, as an entertainment media, and as a vehicle for interactive expressive content, even now the human population is being drawn to a synthetic environment "world" accessible only and exclusively via the Internet. The newly evolving cultural norm is to be "trained" to find this type of environment an acceptable, even desirable alternative to the "real" world. This can perhaps be best evidenced by the rapidly expanding "virtual terraform" referred to by its creators as AlphaWorld. Thousands of participants now visit the AlphaWorld on a regular basis, build houses and other functional structures, and even stage "public" events. The world's first virtual wedding occurred in AlphaWorld just over a month ago, complete with a ceremony, reception, even a legally binding exchange of vows, with all the participants represented by their respective avatar entities. As of this writing a virtual university, with campuses distributed in various countries throughout the world, are actually "constructing" their campus to be linked directly to the AlphaWorld.

As it turns out, an interest in developing a rules based nano-molecular handling mechanism model, which later led to developing procedural process engines with this focus in mind, led to his eventual attendance of the conference. Which, as such moments of fate would tend to dictate, was not too dissimilar from my own pathway into this realm, and the eventual investigation into the development of the logical lexicon models for self assembling, self organizing nano component systems. And in both of our cases, but implemented via very different strategies, we both began to apply our various dynamic nanocomponent behavioral modeling schemes toward the task mimicking of synthetic organisms, and synthetic sentience modeling characteristics.

He started with artificial life research well over a decade ago, conducted research at USC in optical computing, later migrated to IBM and continued work in the optical computing development field, but these are only minimal samplings of his migrating ways. He eventually ended up in Czechoslovakia after the fall of the Berlin wall, and led a software development team populated by former eastern block cold war engineering staff and graduate students. There, he was sponsored by Xerox and IBM to develop specialized document generation software, with his rooms full of computers and fellow engineers in residence in an ancient university building in downtown Prague. In this environment, he began to explore yet another "open ended" series of artificial lifeform experiments.

As Bruce explains in great detail about the history of the alchemist colonies that once thrived in Prague, and the details minutiae of the reverse engineered cloned IBM mainframe computers that he fondly recalled having witnessed there, a moment occurred where the emergence of the global Internet system as a viable, cross cultural "interfacing" mechanism became apparent. It was also at this moment that the cellular autanoma aspects of this interconnectivity grid system, with its potential for self organizing, self modifying "structural" components seized his attention. For the next three years, he drove throughout Croatia, much of eastern and western Europe, and then came to the U.S. and Canada, all the while observing, learning, and formulating his conceptual vision of how this global connectivity grid, and the human interaction with it, would evolve.

NERVES on the net

And thus it is, that it this moment, AlphaWorld is thriving with its myriad virtual "inhabitants", and Bruce is busily developing his NERVES system software, which is a form of VRML 2.0 (Virtual Reality Modeling Language), but specifically designed to support dynamic artificial life and artificial intelligence components embedded into the language.

"One other factor to consider is that programming languages (scripts) are inherently inflexible. Any given script node can only produce a certain combination of behaviors. The effect of realism in a VRML scene could be lost if, say, the digital dog always behaves in a predictable set of ways. If our goal is to make believable, compelling and realistic virtual worlds, then they will have a lot of the properties of the natural world. We posit that the only way to look and act like real biology is to emulate real biology".