

What Matters in Digital Art ? The (Digital) Soul!

Technical innovation is of importance for Digital Art. But the most important is the specific ability of binary systems to integrate all aspects of art into more and more emotional beings.

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Abstract— To have a distinctive future, Digital Art must understand its specific processes and possibilities; We propose here a model of creation where the work of art is the center of a square of which the apexes are matter, spirit, public and author. Each of these poles grows in complexity and formalization, but the pivotal role of the bits allow to make them coalesce in “beings”. Progressively, these beings become more autonomous as well as interactive. They enrich their range of assets and behaviors, and enter the

Does Virtual reality, and with it Digital Art, really have a future as a distinctive “school” or “movement” in Art ? Let us not take that for granted. Nick Lambert, for instance, concludes his rather heavy thesis “A Critical Examination of ‘Computer Art’[1] thus: “I feel that Computer Art is more likely to percolate into the margins of the artworld, rather than stand out as a movement in its own right.”. Indeed, a lot of people, even those engaged in procedural modes of art, tend to think of the computer as a mere tool. Recently, for instance, a teacher in a leading French art school wrote (my free translation) « The computer must not be a production aim, but one of the creation tools, just like a pencil » [2]. Beyond the borders of the “fine arts”, similar trends can be observed. Musicians, for instance, even using computers from composition stage to public performance, do not consider themselves as digital artists.

Hence the emergence of terms like “New Media”, corresponding to the “ubiquitous” and “pervasive” nature of computing, as analyzed for instance in the mind-challenging book “Rethinking Curating”, by Beryl Graham and Sarah Cook [3]. So, some day, will events like Laval Virtual or Siggraph lose their attractiveness and their public as well as their sponsors, and “percolate” into global and mainstream channels and professional ritual ?

To give a clearer idea, I plead here for the specificity of digital art, at least as the core of that expanding digital

realm of emotion and soul. Hence they tend to peer-to-peer communication with their public. Even their production mode becomes generative and author independent. For Artists, the “digital soul” it is a challenge : both a threat and a powerful promise.

Digital art, interaction, emotion, binary, soul.

galaxy. What do we mean when we say “digital” ? I’ll take the Wikipedia definition : “A digital system is a data technology that uses discrete (discontinuous) values.” This definition is much wider than the narrow scope of the binary systems of today, and it opens a space where objects can be more or less digital. Since its origins, music has always been digital (scales), but a CD or an MP3 file is more digital than a vinyl record. (Questions, which may be debated : How far is a procedural texture more digital than a sampled one ? And a Midi file more digital than a Wave one ?) .

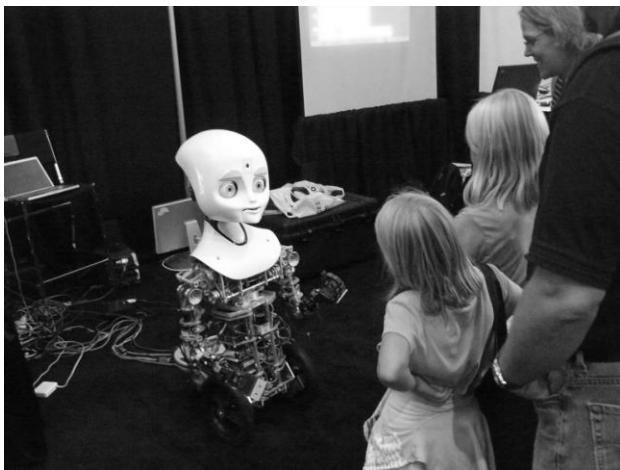
At some stages of this progressive digitalization, the discontinuity of medias, processes or objects may be seen as “artistic effect” itself, as showed some pixelized images in the 1980’s. More subtly, mosaic or pointillist pictures can be taken as forms of digitalization. Or, let us remember, by 1975, it was fashionable to don a digital wrist clock. But, in the long run, resolutions and sampling rates dive down well under our human perceptive thresholds. Then the specificity of digital art has to be found deeper.

I. A TENTATIVE MODEL OF DIGITAL ARTISTIC CREATION

To understand the specificity of digital art, we shall try to build an appropriate model of artistic creation in this field. Recently, Florent Aziosmanoff [4] proposed an answer : an enhanced form of behavioral art that he calls “Living Art”, not so far from the “beings” developed by

Alain Lioret. So he comforted us in our views, but we think that his ideas call for a more formal and general modeling, and that is what we shall try to build here.

Our model of artistic creation is as a square game space, with four apexes : matter, spirit, public, author.. Digitalization grows on each of these poles, and plays a key role in their combination into the work of art, center the scene. We shall begin with the easy point : materials and concepts, then trace the way from the public (channels) back to the artist, and conclude on the synthetic and axial role of the work itself, the “being”. The second part of the paper will develop the specific features or such “Digital Souls”.



A model with four apexes : matter, spirit, author, public (Here, the Kismet robot at Siggraph 2008)

A. Matter : from clay to procedural textures

Pure primal, unstructured, continuous matter is... a purely theoretical view (let us say “une vue de l’esprit”). Of course, atoms and quanta are not perceived as such by artists. But actually they don’t use “matter” but “materials”. The most “continuous” materials are rarely available in Nature. They have to be carefully selected in special places (like Carrara marble) or made from raw products. Yesterday, artists themselves spent a lot of energy to obtain pliable clays, ductile metals, and sufficiently crushed pigments. Today, industry provides these.

In fact, artists learn to play with structured materials. Some of them even love the “grain” of paper or stone. In music, the “pure sound” would be the strict sinusoidal sound, and it is clear that our ears have a preference for more complex timbres and combinations of them.

Digitalization has recently opened the way to more complex, “synthetic” materials, which at present are of some importance, for instance for musicians (synthesizers), graphic artists (procedural textures) and architects (new kinds of concrete and other materials, see for instance *Culture numérique et architecture* by

Antoine Picon [5]. In short, digitalization pushes its control of matter deeper and deeper.

Here the concepts of “matter” and “material” must be extended to virtuality. Any digital asset becomes a material available to mix and remix :

- data captured by sensors (mainly cameras in the future),
- data files provided by partners or downloaded from the Web, be they raw documents or any previous work of art.

And digitalization goes further than capturing or loading samples. Programs may somehow create “matter” from nothing :

- procedural generation of textures [6],
- instrument sound (and even voice) synthesis.

That takes us up a scale of material “levels”, from pixels rasters and succession of instant values (cinema, music) to generic types of materials. And beyond that, to higher level components, like clouds, skin, hair... and even complete bodies with the “poser” pieces of software.

B. Spirit : from the basic “idea” to the complex project

The pure “spirit” of an artistic work is no more at hand than pure matter. The idea, “subject” or concept of an artistic work or project always has some digital basis. As the opening line of John’s Gospel says “In the beginning was the Word”. And a word is always a digital thing, since it can be written on a keyboard adapted to our fingers (*digitus*, in Latin). More formally, words belong to languages, which are systems of oppositions (as Saussure was the first to recognize), or let us say systems of discontinuities. More than this, languages are digital from several combined standpoints : oral phonemes, written symbols and grammatical units.

On this apex, the lower limit of digitalization is the basic creative impulse : I want to make a painting for Mom (or just for the pleasure of scribbling with crayons on a paper), I need to shout my anger, to sing my love... Even if the project implies the use of some digital media, it is not digital art.

Then the “spirit” becomes a project. It gets defined as a particular type of work (a landscape painting, a flute sonata, a fiction story...) it enters into a world of rules, grammars and processes which are more or less “written” and quantified. So much more of course when the project uses programmable tools as an intrinsic part of it.

The more elaborate and complex the project becomes, the more technical tools it makes use of, the higher number of people who take part, and the more it is described in a set of documents. Today these will be computer generated, edited, stored and shared, for the most part. It may start with a small text and some drawings as a storyboard, and progressively develop to a massive set of files.

Hence, from the “spirit” standpoint, digitalization is at least “symbolic” (some words) and at most an enormous digital compound, able to manage millions of “assets” (as they say in film and games industries) and control a workflow involving hundreds of artists and operating on large farms of servers and workstations. In most case, digital is more the rule than the exception.

Spirit, like matter, following the path of complexity and digitalization, from simple ideas and algorithms to elaborate objects, up to fully fledged “characters” and to full narrations with story telling software [7] And here, somehow, digital arts may revive the classical hierarchy of art “genres” (from still life to history painting).

C. Public : from “Mom” to the networks

The public, too, is now a digital ensemble. Billions of people watch TV, play games or exchange on networks. Some paper still remains, for instance the first smile of a grandchild on a card, which will have been jet printed. The mass of art lives through the digital networks. The paper press is digital as well, all along the integrated graphic chain from the writer’s keyboard to the printing machine. Nevertheless, some cases remain of direct, non mediated, and non digital relations with the “public” :

- intimate relations, of which sexual intercourse is the strongest case, along with other family or friends’ informal communication (It is for psychologists and neuroscientists to analyze the digital substrata of these processes, which we can consider as external to “art”);

- face to face performance, be it in a domestic setting like a private living room, or at an open air meeting, like a base-ball game or an immense Olympic games stadium; here, of course, the digital components are of enormous size, power (watts) control and complexity ; and there is always something “live” which belongs to art but remains outside the “digital”.

But live performances are mostly played for TV (and now Internet) networks. In the TV studio or the Olympic stadium, local spectators are important, but mainly as part of the game. The real public is a thousand times larger, at home looking at their screen.

From the artist/author’s point of view, the public is mediated, represented by a set of addresses, defined by broadcasting frequencies, mail addresses, browsers and social networks. The public is closely monitored by audience ratings (TV) or click counting (Internet).

The public, then, is a digital object. Its structures span from general marketing studies down to “one to one” consumer management, scoring and ranking.

But Aziosmanoff [4], for his “living art” brings here more sophisticated concepts. For him, the public is seen through a “perception motor” working at a symbolic level. What matters is not the raw data from a sensor, for example how many millimeters a spectator has moved in some direction. Motors have to provide information of a higher quality : is the public attentive or unruly, distant or actively engaged in the interaction, for instance. With

cheap cameras and open source vision software, this kind of public perception is now affordable to artists. Even basic digital cameras are now able to detect smiles and so trigger at the right time. Thus higher level art will “feel” the audience more and more, and treat it really as a set of “spectators”.

D. The artist : from the lone genius to the team and workflow

This aspect is, perhaps, the most sensitive one in our theory, if we dare to say that the artist him(her) self is more and more digitalized. Do we have the right to downgrade the transcendent creative conscience of the artist to a digital device? In other words, how far can (may, must/must not) artists reduce themselves to structured models, as opposed to the authentic human nature of their vocation ?

Well. Let us dare to say this! After all, from the Cartesian “Cogito, ergo sum” to the Lacanian mirror, conscience does not emerge without some kind of reflection. “Ego” as well as “I” are words, then digital beings.

More practically, the formative education training and development of any artist include explicit formulas, canons, recipes and processes ; the more an artist goes in this direction, the more he accepts to become some kind of “model” : not a robot, of course, but no longer the naïve child longing to scribble on paper ; sometimes, he can even write down these rules and processes ; not many artists do it, and eventually leave that part of the work to the critics or to pure “teachers” ; that part of the training may be termed digital, in the same way as the concept.

Another part of this training (and even drilling), is assimilated not through words but through example and practice ; it has to do with sensorial and motor abilities, like the eye/hand for a painter or ear/hands for a pianist. A critical point, especially in performance arts, aims to so deeply integrate the techniques and their digital parts into the body and mind that he/she can act instinctively “without thinking about it”. Digital processes are present here too, but no longer as a screen, a scaffolding, an exoskeleton, but as an internal and personal strength.

Finally, all artists are digital somewhere, but some may refuse this digitalization if :

- they choose the less digital forms of art (performance before limited physical audiences),
- they have trained themselves enough to be able to forget techniques.

This refusal may concern only a few artists, and as soon as they look for or simply accept some kind of public life, a large part of their work will become digitalized.

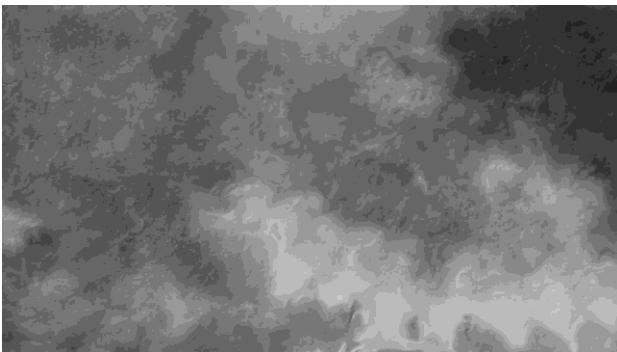
In general, artistic creation today is a team activity. Of course, digital design tools and communication networks open the way to individual creation, of which the blog is the perfect example, sometimes reaching a enormous public. But the limits are rather narrow, since even a gifted individual can rarely compete with large teams of highly specialized professionals and famous artists cooperating in powerful workflow systems. Some arts, like Cinema or Architecture, though team work by necessity, stick to the importance of the single and (preferably) brilliant author. Other arts however, like music and performance accept themselves as largely collective work forces, from the libretto writer and the musical composer to sound and light engineers, group musicians or soloists and, of course, the director. Today this kind of cooperation draws largely on digital tools, from emails in the preparatory phases to scheduling and monitoring during the performance itself.

E. Work : from the easel painting to the "soul"

And so, converging from the four apexes towards the work, the center of artistic activity, the quantity of bits increases along with the qualitative upgrading of objects, from abstract concepts and raw matter, from primal impulse and vague audience, to high level objects : bodies, characters and stories, mature artistic involvement and richly reactive public.

At the start, there is practically nothing. Just the first oppositional bits : author/public, spirit/matter. Then structures build up in space. Transient in pure performance arts. More or less persistent in fine arts or literary works.

Beauty and genius, of course, do not depend on this consistence, beyond the minimum, to connect author and "public". In love, this fundamental art, just a silent smile or kiss may express an unsurpassable joy and beauty. Some strokes by a Lascaux artist, a Rembrandt or a Picasso, some short melody by a great musician (The "small phrase" of Vinteuil Sonata in Proust comes to mind) may express all the genius of art.



Beauty may do not depend on quantity (Courtesy of Alain Lioret)

But a most of humans are not content with just some brush strokes or simple tunes. We desire larger constructions, longer music, impressive buildings and big shows, and in some cases, interaction. We hope for a longer "duration", as Aziosmanoff says. This demands not only the expansion but also the coordination, or better, the integration of the four poles.

And it is here that digitalization proves its unique abilities, and hence the specific meaning of "digital art", even if, in the future, this technical term will be outmoded by more fashionable expressions such as "behavioral", "generative" or "living"art. At this level, Art perhaps is just mimicking Nature, in which Life emerged from the primeval soup using a digital device : the DNA nucleus.

II. THE DIGITAL WORK OF ART : IN QUEST FOR AUTONOMY

A. "Elementarization", from pebbles to bits.

To build robust high level complex objects, we need to begin with fragmentation. From Aquinas Summa and the Descartes Method to the Bourbaki Elements, ambitious projects use varieties of elementarization. Were not the pristine human tools, pebbles and chopper (cutting tools) ? In some cases we are even now able to control elements of matter down to the individual atom (in some digital chip laboratories). But in most cases, it is convenient to use not the smallest possible parts but middle sized components, letting specialized industries doing the lower level fragmentations and offering to artists rational catalogues of bricks and mortar.

Language here is both a model for all technologies and a central technology for any conscious action, art in particular. This, of course, is evident in writing arts. To create powerful stories and sagas, we need both a large vocabulary and a versatile grammar. Languages have shown progress, at least since the emergence of mankind up to Antiquity. Primitive languages have few words and few grammatical forms, still remaining close to animal cries. en the Saussurean "system of oppositions" developed. The demands of writing helped this construction and took on an elaborate form of digitalization, with the building of an alphabet, reaching a sort of optimum with the Greek alphabet and all the modern (Western) languages, with around 25 letters and some complementary signs (accents, punctuation).

This form of digitalization applies (more or less) to all arts, and not only to writing. It is basic for music, due to the particular nature of our sensorial hearing system, basically attuned to systems of discontinuous scales and their organization in "tones". Estelle Thibault [7] called this "elementarization". In France, this idea was initiated by Charles Blanc in his "Grammaire des Arts du dessin" (Design art grammar) [8] in 1867. Blanc wanted to present to a large public, a general introduction to the

Arts and their history, in particular Architecture. This may be considered a modern rethinking of the Roman architect Vitruvius. Through the XIX and XX centuries, this scheme of a set of elements and a grammar to combine them together was fruitful. This line of thought inspired the teaching and the practice architects. And it made even deeper progress with materials, particularly with concrete and, today, with synthetic materials, as Antoine Picon [5] indicates.

At some times in the historical development, this digitalization/elementarization imposes a kind of rigidity (or aliasing) as when we build objects with Lego bricks. In painting, the use of visible brush strokes used for instance in the second Titian, or later the impressionist touch followed by the cubistic motto of Cézanne and the theorization of pointillism and cubism led to some primitive forms of computer arts with visible pixels. In architecture, elementarization reached its peak of aliasing visibility with Le Corbusier (see Paul Turner [9]) and the Bauhaus. In the 1970's pixels were even seen as a congenital defect of digital arts, doomed to sampling and digital coding.

But later comes the time when digitization goes down beyond the limits of our perceptions and leads to radically new possibilities of generative grammars. Architecture is particularly emblematic here : the "modern" buildings of Le Corbusier and Bauhaus have been outmoded by "post modern" architecture. Here, the indefinite adaptability of reinforced concrete gives free way to the use of highly complex patterns [5]. And digitalization provides the deep nerve that lets the designer to go free hand on his workstation, that takes care of the strength of materials with high level of mathematical models, and that finally drives the generation and combination of synthetic materials". (That may even extend to fine cooking, with "molecular" recipes).

B. The pivotal role of bits

The basic power of digitalization stems for the radical universality of the bit, which can be as well an arithmetic unit (in base 2), a logical value (true/false), a symbolic reference to a pair of objects of any kind and, last not the least, the state of a physical binary device.

The first to fully grasp this central role of binary logic was Von Neumann (with his fellows scientists), as stated in the fundamental paper [10], "*We feel strongly in favor of the binary system*", for three reasons :

- hardware implementation (accuracy, costs),
- the greater simplicity and speed with which the elementary operations can be performed" (arithmetic part),
- logic, being a yes-no system, is fundamentally binary, therefore a binary arrangement... contributes very significantly towards producing a more homogeneous machine, which can be better integrated and is more efficient".

Then we can word a major assertion of our contribution : Art is digital as far as it draws on this pivotal role of the bit. At this stage, we can see why the phrase "the computer is no more than a tool" becomes misleading. Of course, in its material, physical dimension, a computer is only the basis of a process that can be termed "computing". But "computing" is not only applying mathematical and logical rules, but also

- receiving, interpreting and storing information (inputs and storage)
- transforming information into signals and in some cases material operations (outputs, devices control)
- above all getting "control", that is taking account of conditions and states to generate commands.

In short : computer is a tool, OK. And computing may just be a cheaper and more easy way to create works of traditional types. But computing may also lead to radically new kinds of Art works. Up to now, the results have been rather limited. But the space in front of us remains largely open, and the important future is that of more and more autonomous works.

C. Autonomy : freedom in space and time

Autonomy has levels. From the most basic material independence from space and time up to... actually, the sky is here the limit. Let us see how and why.

At the lowest level, autonomy is independence. At pre-digital stages, we can say that an easel painting is more autonomous than a simple drawing on the sand or a fresco in a church. Some billions years ago, life itself freed from sea waters then from soil attachments, using DNA and neural binary technologies. Digital devices do the same in our days, and are making progresses every year, as show the mobile devices (cellar phones, game boxes, portable computers). Tomorrow, due to Moore's law, chips will keep their way to micro- and nano- scales, using not only less space but also less energy.

But space independence (could we say virtuality ?) is more radical than miniaturization of the physical devices. Digital assets (data, programs) are files. The "real" place where they abide is of secondary importance. To operate them, all that we need is an address (and, of course, communication lines to reach this address). And even addresses become less and less "local", more and more "symbolic" if not semantic. On the first computers programmers had to use "absolute addresses", pointing on materially specific places in the memories. That was still possible on the first "micro computers" of the 1980's (and even enjoyable in some cases with the "peek" and "poke" instructions of the Basic language). Now, who cares (and who would be able anyway) to know where on Earth are the web pages and sites ! To get them, you do not even have to remember the URLs : search engines will know for you.

As for time, freedom is not so wide. The computer is now a Well's time machine. But when something has been stored, you can retrieve it on demand. In some cases, this feature has dramatic emotional effects, for example when you find a record of Grand'ma telling an old story some 30 years ago.

D. Autonomy : motors

Autonomy calls for more than cutting ties. It is good to weigh anchor, but you are... at bay if you cannot set sails, or even better (for autonomy sake, ecology apart) start an engine. This form of autonomy has been searched for since antiquity, and there have been along the centuries, a progress in various kinds of “automata”, using “analog” components, including some kind of “motor”. But non digital automata cannot reach very high levels of complexity. A sort of summit has been reached in the XV century with the astronomical clocks, which anyway were digital for a large part (since based on numbers and hence digits). Some progresses have been made after that, with the Vaucanson or Jacquet-Droz automata. Cinetic art, highlighted by Calder, Tinguely or Moholy-Nagy pushed the exploration for more specifically artistic process, but still within rather narrow limits.

Electrical motors widened the abilities of automata, the variety of their movements. Two particular pairs of automata have played a major role in art development : the camera and projector for cinema, the recorder and player for sound and specially music.

A rotating motor is a cyclical engine, then slices time in periods. A first hint at digitalization. Cinema goes further with its frame sequence (which induced Bergson then Deleuze [11] to elaborate on “cinematographic illusion”).



Digitalization allows movement (Dancers by Michel Bret)

But digitalization proper calls for the properly digital motor : the clock, with its purely binary cycle, which can be reduced to nano if not picoseconds. Such speeds, many types out passing human (animal) time perception, allow us to gear on the digital clock any kind of slower rhythm or complex space and time structure.

Aziosmanoff [4] makes good profit of this “motor” concept (which he revives from the “inference motor” of the expert systems, a fashionable component of Artificial Intelligence in the 1980’s, which finally failed to reach its promises). His “living art” theory specifies three types of motors :

- perception (of the public attitudes),
- expression (presentation to the public)

- behavior, “an automatic simulator or the actions and reactions that the author wants his work to take and show” (our free translation).

We could also find inspiration in the six motors or “image movements” that Deleuze distinguishes in cinema : perception, affection, impulse, action, reflection, relation. (It is perhaps excessive to draw Deleuze in our views, since he was not an engineer but a philosopher, and more prone to postmodern paradoxes than to programming. But I know some digital artists who consider him as one their major source of inspiration).

We are confident that our model is able to give a proper place and role to the various kinds of motors.

- At the heart of the work, the behavioral motor of Aziosmanoff, reflection and relation image-movements of Deleuze.

- On the “spirit” side, the interpreters and compilers, and more generally the tools which translate high level concepts into lower level terms and procedures ; programming technologies have evolved from direct “machine language” to object programming ; for reasons which it would be interesting to find, object programming did not evolve to “agent” programming, in spite of the early promises of languages like Smalltalk.

- On the “matter” side, the progressive layers of operating software, from the chip integrated Bios to the graphic user interfaces of operating systems, through the today highly sophisticated mechanisms of system operations, messaging, multi-programming, multi-core and even cloud-computing management.

- On the public side, the perception, affection, expression and action motors of Aziosmanoff or Deleuze. If the public is passive and “offline”, the motors here are the “player” pieces of software. If it is called to interact, that will take to the special software developed by artists, or the user interfaces of games.

- On the artist side, authors can create offline with editing software, or online in performance arts (DJ and VJ tools for instance).

On all these sides, the level of autonomy depends on the sophistication level of the work. In the most simple ones, they are just part of more or less autonomic creation tool. In the most elaborate ones, the behavioral motor tops a hierarchy of more and more autonomous agents dealing on- and off-line aspects of artistic creation. It may be the workflow management of off line creation (cinema and games) or the control room tools for performance.

The behavior motor itself may take the form of a cooperative system of agents or beings, using for instance neuronal networks or Darwinian generative processes.

D. *The self through recursion*

A crucial point in digital devices is recursion, or auto reference". It's an affordance of text in general, but strongly enhanced by binary forms. Formally, that is expressed in the classical formula of automata : $S = f(I, S)$. (formally, it would be more correct to write $S_t = f(I_t, S_{t-1})$). In other terms, the state S of an automaton after each cycle or operation is a function of :

- its state at the end of the precedent cycle
- the input information during that cycle.

(S could stand for system or "self" as well as system).

The result of the work is sent to a public through an output function $O = g(I, S)$.

That brings up on the formal/digital theater a deep philosophical concept : the "self". The basic formula may be termed as "The system S and what it shows to its environment O , depend on himself (or would you rather say "the state of its self") as well as on what it gets from its environment.

We have here two limit ("degenerate" would say a mathematician) cases.

The cinema projector is an example of the first case. It is of great practical use and of minor "artistic" interest : the being has no meaningful action on its inputs. Its functions are reduced so $S = S$ and $O = g(I)$, g being only an expression of distance or difference between the emitter and the receiver (real time, live TV) or time delay (on demand access to a library of records). Even if it looks basically simple and transparent, that may take to highly sophisticated systems to ensure large broadcasting diffusion, resilience (continuity of service) and protection against the many sources of "noise" in order to reach high fidelity. But the "being" autonomy is appreciated only as the reliability of a good messenger or librarian.

Traditional mechanical automata, our second case, are more properly artistic : the being liv its own life, without inputs In this case, the function reduces do $S=f(S)$ and $O=g(S)$. Artificial life belongs to the same category, with S describes a close space where elementary "beings" live, grow and multiply from an initial state.

Of course, as the number of different states (for digital systems, the size of its memory) is finite, the system will more or less rapidly fall down on a limited operating cycle, making it boring for the spectators. Though written about mechanical automata, the book *L'âme* ("The soul") by Elsa Triolet [13] shows the long quest of automata fans to go beyond this rapidly exasperation facing an isolated automaton. In this novel, the quest is desperate : the artist-hero reaches the limits of mechanical automata.

Aziosmanoff [4] opens here the way to a quantitative approach with what he calls "duration of the relation". We can propose a (lightly) formal definition : the time after which the public reaches saturation and leaves the work for another one (in a museum, for instance) or swaps out to another activity (at home). It is here that digitalization shows the full measure of its effectiveness, affording to combine virtually an unlimited quantity of components of

unlimited complexity. Here also, the spectacle has its limits and the spectator, past some initial minutes of fascination, loses interest.

Can we go further, and create autonomous being of sufficient sophistication to keep the spectator attentive for a long time, and even for a whole lifetime, in some kind of peer-to-peer relation ?

There are three main types of answers :

- the positive one (reductionist) : some day, computers will outgrow their human genitors, and will satiate our variety desires before exhausting their abilities ;
- the negative one (transcendentalist, or vitalist) : man (as well as life) is greater than any machine, and anyway even his brain does not work like a computer ;
- the explorative one (empirical...) : whatever be the final answer, the development of more and more powerful digital works is interesting if not exhilarating, and perhaps even a duty of artists, as a form of research into our future. We shall now elaborate on this third way.

III. THE QUEST FOR SOUL AND PEER TO PEER RELATION

We can look for answers in the automata formula above. What the public sees is the output : $O = g(I, E)$. The "duration" can grow with more, inputs, more internal states or more elaborate algorithms.

A. *The quest for more "intelligence"*

A classical solution to augment the variety of outputs is the call to random, which is unpredictable by definition. There are several way to get random sequences of figures. The basic one, offered by many programming languages anyway, is the "pseudo-random" algorithms, generally using a sequence of arithmetical operations (for instance multiplication by prime numbers and selecting only a part of the binary string resulting of it). It may be completed by a reading of several system value difficult to be predicted, like clock values, internal temperatures or battery load level). A theoretically perfect solution is offered by nuclear devices marketed for instance by the European CERN. But, even with very long algorithms or quantic tools, random does not take us very far. After all, to get random images, you just have to switch off the antenna of your TV receiver. Your eyes and brain will rapidly globalize the result into "white noise".

To get more, a lot can be obtained with appropriate algorithms. The most elaborate ones combine generation algorithms, using sets of patters, colors and sounds. That is the "algorist" method. Artists working so are able to exhibit some pleasant works... which they have selected according to their taste among the high number of pure random generated works.

A step further can be made with evaluation algorithms (self evaluation = auto norm). They can simplify this task using more or less sophisticated evaluation algorithms, such as "complexity" measurement (see for instance Afig 2009).

B. *The quest for more inputs and memory*

Algorithms may be completed also by any type of pertinent “asset”, from numerical data and textual documents to sound and video libraries.

Structurally, these assets may be seen or built as a part of S , so long as we consider S , the “space of states” of automata, as a container of assets. After all, any digital file is nothing more than a set of bits, each of which has a one or zero state. Indeed, here also, the pivotal status of the bit helps considerably to use, and use at best, a same material and functional device to store any kind of resource.

We can also increase the “duration” with access to external assets (the I factor of automata) :

- Sensors of any types, mainly microphones and cameras getting data from the environment.

- Telecommunications and mainly the Web. Some kinds of “web art” do not go much further than tapping on the net and presenting the results. Indeed, the web browsers themselves are carefully designed and can be taken as a form of Art, along with the website design. Applications like Readability push the processing a little further. By contrast, the Mechanics of Emotions (by Maurice Benayoun) uses web data only as a starting point in a multiformat artistic process.

C. *The quest for a more relational behavior*

But communication with the public is the most attractive way to get inputs and, better, to involve the spectator. It is frequently considered as a basic component of new media. It is of course a constitutive part of games. And here the success is even to great, since it may lead to addiction. But, until now, games stay out of the proper Art gamut.

In the sixties, interactivity could even be desired as a more “democratic” form of art, breaking the wall between the dictatorship of authors and actors on one side and the submissivity of the lay spectators, heretofore called to be “spectators”. This can apply not only to on site performances but on TV and so more to blogs and social networks. The results seem more convincing in technical discussion groups than in collective art. Does the digital communication add really much to the grand traditional meetings (religious and sports events in particular) where the public is indeed called to take his part, but within well marked tracks ? A lot of interactive works of Art, shown in digital art events, do not give to the public a real free space to take its part. It looks more like a way of showing the creativity of the artist than to imply actually the public into the creation.

Things are changing rapidly now. Some years ago, high level interfaces were simplistic (joysticks at best) or heavy and costly (tables, large screens, markers for motion capture, plus high level professional software to make proper use of the signals). Today (around 2010), Wii, Kinect, markerless capture, and probably a lot more to come, enter everybody’s homes, along with the

appropriate software for games, anyway using powerful machines).

On the other way round, sophisticated interfaces like goggles and caves or haptic devices can be dispensed with, since our mind is powerfully gifted to take us fully into action with even minimal interfaces. Just look at kids involved in a game around the home computer ! As for global audiences and, so to say, collective or cooperative playability, its importance and development are stressed on and taken into account by innovative curators (see the book of Graham and Cook [3]) as well as theater professionals (see the collection of texts gathered by Garbagnati and Morelli [14]).

Anyway, the desire to “take part” is not shared by everybody and not a permanent attitude. Art is most of the time taken as an entertainment, be it a well deserved rest before the TV screen after a days work, or a collective pleasure to be shared with friends along with social behaviours before and after the show, like hugging, dining ... “and more if affinity”. Did not Artists have excessive expectations from this side of the creation? At the other end, some kinds of art are interactive by nature. Tactical media perhaps, but most certainly and for nearly anybody, games. What Art has to do now is not to play the game of games (if I can say so), but to climb a step up above their basic instincts : kill or die, win or lose, step on the top scale of the podium. Art requires less of animal brutality and more soul. How shall we achieve that ?

D. *From autonomy to emotions*

Finally, the bits, with their pivotal abilities, lead to constructions that integrate the four apexes (matter, spirit, public and author) into beings of real substance, largely autonomous and unpredictable. They are an avatar of their author since they present his/her “speech” (“discours”, as Aziosmanoff says) to the public. They are an avatar of the public for the author, who perceives the spectators through its mediation. They give matter to the spirit and spirit to the matter. In the end, more than anything else, such works of art exist in their own right and play for themselves.

Today we see that these works, in some or other aspect, equal or outgrow human capacities and values. Adults as well as children will play with them rather with their fellow human beings. It is a real threat. One hears that the decline of the Japanese population is due somehow to the fact that sex toys (of various kinds) replace actual male/female sexual intercourse. Drones at war, surveillance systems in town and, soon to come, automatically piloted planes and cars... are replacing their human counterparts. Then, will robots definitively replace us, with populations of post-human beings ? And what of Art ? Are “new media” only the forerunners of the post-human era, and even the “avant-garde” of post-human armies ?

The challenge is no longer about physical speed, brute force or computing power. It plays on the highest features of our minds : cleverness, long range strategy, purposeful

behavior and even the heart of human spirit : emotion, nearly a synonym of the soul.

Games progress regularly along this path. “Non player characters” (NPC’s) are a first way to explore and embody the “soul” complex. Here we have autonomous beings, sometimes donning an elaborate set of behaviours, assertively persistent in time and possibly exhibiting personal development. See for instance Millington [15]. But these foe or friend partners lack soul, beyond primitive types of personality. In fact, even Science Fiction writers are up to now unable to create really new characters. Asimov’s *I Robot* remains an unsurpassed projection. Recent grand epic (StarWars, Lord of the Rings or Avatar) are socially devotees of the past, negative towards technology and unable to open new horizons, to propose a new soul, or new souls, to the World to come.

Some robot engineers go further, and are not afraid to consider emotion as a “functional perspective” : it is even the title of an on line web text by two MIT scientists Cynthia Breazeal and Rodney Brooks []. Emotion is a very promising perspective, and is explored in a variety of ways :

- using material devices and algorithms to give “expression” to robots and characters in films and games ; Disney’s Walle and Eva are masterpieces of this genre, some 30 years after R2D2 and 6PO in Starwars ;

- recognizing human emotion through diverse sensors but mainly, as for humans, through cameras and more and more sophisticated recognition and understanding software;

- topping the architecture with a high level of behavior including “emotions” ; that is now frequent for physical robots as well as software agents in services of all kinds [17].

How far can Art go in this direction ? How far can artists here play their role as explorers and “avant-garde” onlookers for the rest of Society ? Will they stick to human character mimesis, like the Pompier art in painting, or be able to go beyond, to explore some post-human kinds of souls other than animal-human chimeras and monsters, or brute criminals, cops or politicians ? Here is the real challenge today’s and tomorrow’s digital Art. OK for HD, 3D (or even 4D) images and sounds, immersive spaces, MMO, MMOG, MMORPG massively multiplayer games. Some two thousand years ago, according to Matthew (16/26) Christ said “What is a man profited, if he shall gain the whole world, and lose his own soul”. To day we have to rephrase the question again : What will we gain by building whole new worlds, if we are unable to give them a new life with new souls ?

But, even if we push ahead with realistic mimesis of humans, even the most emotional digital beings will remain different to us. At least as long as they use a binary technology different from an animal one. DNA is digital, but not the way a computer is. Described as a linear string, the codes of life resemble a program. But they are deeply immersed in less rigid carbon structures

than the metal or silicon structures of computers. In particular, the DNA chain folds upon itself, and that is important for its operations. And in the reproduction process, the nucleus is only a part of the game. The rest of the egg has its part (Perhaps this has been overlooked since computer science is made mainly by males, and the spermatozoid role is practically limited to code).

E. Selfreproduction and ... love ?

If we really want to get dramatically new but attractive partners, we must think out new generative processes to bring them to life, or leave them to generae live by themselves. At present, there are two ways :

- the technological way, with its artistic variant, in the kind of process we started this article with : author/public, idea/matter and the emergence of a new work/being; thus were born into life both the Sistine chapel as the Von Neumann computer ;
- the animal/genetic way, with a lower level of duplicating itself (at the virus and bacteria level), and a higher level, the sexual one, with adaptive and evolutionary properties which, over billions of years, have led to the emergence of human beings.

This also goes with some architectural variants around two main types :

- the centralized or hierarchical model; for instance the classical computer with its CPU (central processing unit) and the auxiliary ones (for instance the GPU in graphic computers or the peripherals with their control units)
- the connectivist model, with no dominant machine, but a network of processors with some system of rules or coordination in order to ensure survival (for instance, neuronal networks).



Walle and Eva : clearly not designed to sleep together (A Disney film).

But emotions and recursion concur in our souls for a major function : reproduction. Reproduction is recursive by definition. And never without some relation to Art. Even in vegetal and animal beings, flowers and love

parades are highly visible expressions of emotions. In animal reproduction, emotion is even a necessary condition for successful sexual intercourse. Hence the question about works of art points to emotional beings with some kind of soul. Will they ever reach the stage of self-reproduction and even love? As far as I know, robot reproduction has never been envisaged by scientists or artists in any other way than replicative production. The multiplication of broken brooms in *Fantasia (The Sorcerer's Apprentice)* is perhaps the nearest equivalent, in a humorous way. Some authors have shown sexual activities of robots, but only as sex toys and still more frequently in rather sado-masochistic relations. And the couples in *StarWars* or *Walle* are clearly not designed to sleep together. Will, some day, Hollywood, Bollywood or Japan studios dare to break the taboo?

On the other hand, the mere reproduction of works of art by traditional means (from Durer engravings to digital copies) have always been met by mixed feelings. Malraux [19] or McLuhan [20] hail their positive aspects, but Walter Benjamin [21] and a lot of authors who followed him see it as a debasement of Art, with the loss of the original's "aura", an enslavement to mainstream populism... and a commercial problem for the high level Art market.

In fact, Art has always progressed through combinations of influences (even copies) and innovation. The Greeks knew and admired Egyptian Art. Antiquity never ceased to inspire artists even through the darkest centuries of the Middle Ages (see the books by Panofsky [22], although the Renaissance artists believed they were making a leap into a new World. Up to recent years, these transmissions of images, schemes and ideas were costly and time consuming and, for this reason, limited to the happy few. Today, more and more, the capture of sound and images as well as net diffusion give larger dimensions and warmth to something resembling the primeval "soup" from which Life emerged some billions of years ago. Remix unlimited!

It is for me a deep conviction: bits will form the fundamental elements of these new beings. And we, digital artists, can do a lot to help them emerge... if we are daring enough to leave behind us the old models, be they humanist models or the present "mainstream" clichés of the entertainment industry and if we help them to bear "children" who could be far more different from us than we are from our parents. Let us sing with Tina Turner: "We don't need another hero We don't need to know the way home. All we want is life beyond the thunderdome".

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