Uses of computers in the graphical arts

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Abstract

Going through examples examples in graphical arts and interactive installations, we show how computers can be used by artists, and why they help shape a new medium.

Keywords: Computer art, graphical art, interactivity.

Introduction

Computers are useful to most creative domains in the digital age. In the graphical arts, there are software used to create digital paintings, but one can also manipulate and transform any digitalized image. In music, there are tools to assist composers, and hardware tailored to record, edit and broadcast. In literature, entire books can be authored, redacted and published using only computers. And that doesn't even begin to cover the software in daily use in architecture or at video games companies. But what about creative expression in its purest form: art? How computers can be used to assist artists, and produce works of art on par with traditional medias? More importantly, why choose computers to produce art? What benefits do they bring?

We'll answer these questions in two parts. The first part focuses on using computers as tools to aid artists to conceive and produce artworks, by covering three examples in the graphical arts. The second part dives into interactivity in art, how computers can help artists in directing interactive installations, and why this really is a new way to engage and affect the audience.

1 The new tools

1.1 Henry's drawing machines

A pioneer of computer art was Desmond Paul Henry who, in the early sixties, turned bombsight computers bought from army surplus into drawing machines [6]. These mechanical devices were originally used by bombardiers during World War Two to predict when to release their bombs, given parameters such as current speed, altitude and wind characteristics. Henry had a fascination for machines, and began tinkering with them at a young age. To make his drawing machines, he took apart the bombsight computers and reassembled them. On the way he added, among other things, pen holders in order to enable the machines to draw the results of their computation on paper. These drawing machines could not be explicitly programmed like their digital counterparts. Henry could however obtain the desired result by a great deal of experimenting and tuning of the machines' gears and knobs. After many hours, and even days for some pieces, the machine produced works that consisted of intricate curvilinear patterns with few colors. Henry could then complete them manually, or hang them as they were.

Figure 1: Desmond Paul Henry, *On the beach* (1961), Victoria and Albert Museum.

Aside from his fondness of mechanical devices, why did Henry choose

to use machines to draw in his stead? How did they benefit him? First of all, having computers used to cause death during the second World War create emotionally engaging artworks is quite poetic. Moreover, the resulting paintings have a distinct mechanical feel to them, while retaining the conscious composition of a creative mind. Another reason would be to allow Henry to focus on composition rather than execution. The drawing machines being analog devices, their computation process solely relied on gears and motors, thus they could not reliably recreate the same piece over and over. A loosened screw could affect their outcome. This element of chance allowed Henry to relinquish some control to the drawing machines, since he could design the overall shape of a piece but he could not anticipate the minute details. Henry welcomed this unpredictability, this "Cybernetic serendipity" — incidentally the name of an interactive exposition he participated in — allowed a great variety in the machines productions.

1.2 Verostko's expert system

This dialectic between control and uncontrol is also the central theme of the works of Roman Verostko, another computer artist who uses plotters — printing devices used in technical drawings — similar to Henry's drawing machines. However, while Henry favored analog computers for their mechanical beauty, Verostko's plotters are hooked up to modern digital computers. These PCs are driven by a personal expert system designed by the artist around 1988 and called Hodos.

Hodos mainly relies on constraints defined by the artist. Preferences for shapes, scale, form and color are described as constraints and fed as input to the software. For instance, the artist might want to have lines going from the left hand part of the paper to the right hand part, without passing through a given square in the middle. In addition, he might indicate that only a set number of lines in the upper part should have a warm color. All these constraints are then obeyed by the program, which must choose the points to plot, and with which pen to do so. The result is printed on the screen first, to allow the artist to make all the necessary changes to fit his vision before committing the result to the plotter for a lengthy drawing process.

With a digital computer, the output of the algorithms used by the artist to produce his pieces becomes predictable. Unlike Henry who had to let machine, in his own words, "do its thing", unreliability is

just an option for Verostko, and one he favors. To allow more room for chance, the rules fed to the system are applied within a parameterized margin of error. Verostko draws an analogy of his creation process with the biological phenomenon of epigenesis: the software constraints are the genotype, and the resulting painting is the phenotype [9]. In this analogy the artist can be seen as a geneticist who tweaks a subset of the genotype in order to obtain the desired traits in the phenotype. While some genes (constraints) code for a distinguishable trait, the interaction of all the genes during epigenesis can lead to practically unpredictable results. Thus, Verostko voluntarily relinquishes control over the finer details of his artworks by using randomization. This allows him, like Henry, to focus on the higher level of artistic composition.

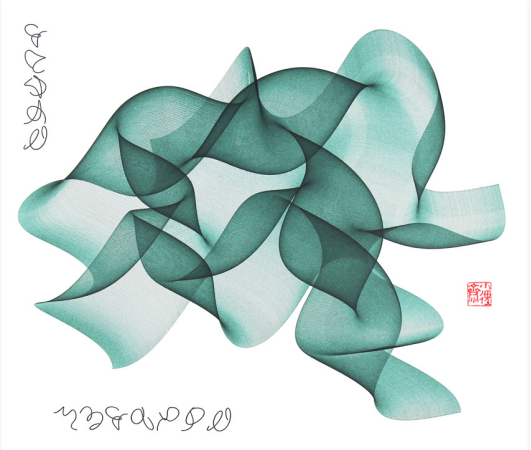

Figure 2: Roman Verostko, *Algorithmic Poetry for a Three Story Wall* (2011).

The benefits of using computers for his drawings are the same as they were in Henry's case. Here again, the opposition of mechanical feel with human creativity is striking. Verostko's larger artworks can reach thousands of plotted lines. While a sufficiently patient human artist could produce similar artworks, the machine will do so in considerably less time. The computer is both faster and more precise. Verostko's works are a nice example of mixing computers with traditional medias, pen and paper in his case, but computers alone can be used to produce and present art. That is precisely what is shown in the third and final example.

1.3 Sims' genetic images

In a typical art gallery, visitors will come to look at paintings, drawings or sculptures from one artist or from a group of artists. Artists create and visitors assess. A way to inverse the roles is to let the visitors create artworks, by using a computer. Karl Sims notably used genetic algorithms to evolve the images displayed to the visitors of his Genetic Images media installation in 1991 [8]. Sixteen screens arranged in an arc each greeted visitors with a different image. The screens were also equipped with a sensor used to register how long visitors stayed in front of each one. The popularity of each image was thus measured and turned into a score, or fitness value. Regularly, a new generation of images would be generated according to these fitness values. The algorithm to generate these images is inspired by evolution theory: the strongest individuals reproduce more, thus passing more genes to the next generation, which is also stronger as a result. In Sim's installation, an image with a high fitness was more likely to be selected for reproduction, while an image with a low fitness would be replaced by the offsprings of the more fit population. Thus, the more popular images remained in the following generation, and passed their characteristics to their offsprings which replaced the images neglected by the visitors. This is aptly called a genetic algorithm. With each generation, the images came closer to match the interests of the current batch of visitors.

Figure 3: Image evolved from a genetic algorithm designed by Karl Sims in [8].

Here, the advantage of using computers is obvious. Contrary to Henry and Verostko, who both used the computer as a tool to aid in

the production of artworks directed at traditional media, Sims' installation relies solely on computers. The genetic algorithm could not be emulated by humans artist, not in the same time frame, and not without bias towards image features. Using computers allow real-time art creation. Incidentally, this installation doubled as a publicity stunt for Sims, who was then part of the Thinking Machines Corporation that produced the famous Connection Machine made of 32,678 tiny processors and tuned for the Lisp programming language, the very machine Sims used to run his genetic algorithm.

But there was at least one more reason to use computers. In this installation, the artist has no role to play in the production of the final images. Sims gave the program its building blocks, the images DNA, but his work is the installation itself, the software that drives this genetic selection. The ones to create, or rather influence the creation of the images are the visitors. With his genetic algorithm installation, Sims enabled the public to participate in an evolving art piece, taking advantage of a new way to interact brought by computers.

2 A new dimension: Interactivity

2.1 The emergence of interactive installations

As written previously, computers open a whole new spectrum of possibilities to modern artists. They give them powerful assisting tools for the creation of classical pieces of art and even let them explore new fields completely based on computers mathematical and algorithmic capabilities. Nevertheless, one of the major additions of computer science to the artistic world may be interactivity.

Before the arrival of computers as an artistic tool, interactivity was an uncommon component of art. Since immemorial times, pieces were completely static. With theatre being an exception (in ancient Greece, audiences didn't hesitate to aknowledge the actors of their opinions during a live performance), works of art were most of the time only available for viewing (or listening) purposes and the viewer stayed a mere consumer. No one could brought a hammer and a chisel in order to customize Rodin's Thinker or clap his hands during Beethoven's seventh symphony to participate to the piece rendering. As these naive examples show, it was not a question of mentality with respect to the

art but rather a lack of an appropriate support.

The expansion of the use of interactivity in art takes its roots during the 60's, a decade in which people were given new freedoms and more civil rights. With this global trend came a wish from the audience to become more involved in the creation process leading to a work of art. Some artists also wanted to share their creative power, but few appropriate media were available. Experiments based on automata and mechanical systems were attempted, like Marcel Duchamp's *Rotary Glass Plates* and *Rotary Demisphere*. Both of these installations were based on optical illusions and the perception of a viewer varied according to his relative position to the piece.

We could separate interactivity in contemporary art in two categories. Firstly, a piece can be considered interactive in the way that it reacts to the artist's inputs and that it can potentially behave differently at each representation. Secondly, a piece can be considered interactive in the way that the audience has the possibility to influence its outcome. Interactivity introduces a whole new dimension to art: an interactive piece is not a fixed product anymore but rather an evoluting system, sometimes near living, that the audience has to manipulate in order to appreciate.

The computer is an often cryptic machine and to be able to master its capabilities, one must demonstrate quite a reasonnable amount of patience and inducement. A bridge had to be built between the worlds of computer science and art in order to permit artists to express themselves without restriction. The first serious attempt at making so was Design by Numbers, a creation environment conceived in the Massachusetts Institute of Technology in 1999 by John Maeda, a professional computer scientist and artist by hobby. *Design by Numbers* hides from its user the shady details of the computer actions and generalize them to the use of virtual pens and papers. In spite of Design by Numbers eccentricity, it received a disappointing reception, mainly because of its limitations. Two years later, in 2001, Casey Reas and Benjamin Fry, former Maeda's students, created *Processing*. The main goal of Processing was to give to willing artists and techno-curious a friendly programming language affirming the graphical and musical capabilities that computers have to offer. Processing knew an instant success, mostly because it found the right equilibrium between complexity and freedom of creation. Furthermore, the MIT project is based on Java, one of the most

widely-used programming language. This descent is one of its success cause as it is compatible with a wide range of pre-existing libraries, and thus can handle three-dimensional scenes or complex sound settings without a lot of background word. Processing is mainly used to generate artistic rendering but it spawned a whole family of programming environnement specifically designed for art.

One of its derived language, Arduino, focuses on the interactive prospects that could emerge from Processing. Arduino comes in two part, a development environment derived from Processing and a physical electronic circuit-board. Though it was not originally destinated to an artists crowd, as the goal of the project was rather to conceive a cheap and robust electronic board for students, the artistic community quickly became fond of this product. With the opportunity to program an electronic board comes the option to use sensors, LEDs, soundspeakers and all kind of electronic devices that can communicate and choose which actions to execute depending of their environment; thus emerges interactivity.

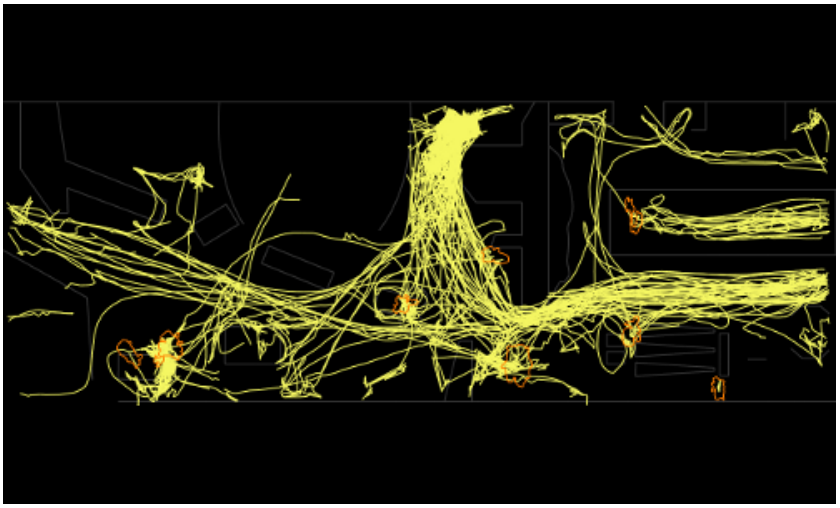

Figure 4: Eric Siegel, *You Are Here* (2004), New York.

We could cite *You Are Here* [7], By Eric Siegel, as an interesting example of interactive art. In a closed public area, cameras hanging from the ceiling are pointed downward to record the movements of unsuspecting bystanders. As they exit the area, they are greeted with a screen that displays a visual representation of the paths they followed superimposed with the area plans and the random paths of other people.

This installation, which aim is to question the heavy use of electronic surveillance in today's society, let the passers-by be the composers of the final piece, even if they are unaware of it, whereas the artist hold more of an engineering role.

Figure 5: Ole Kristensen, *Body Navigation* (2008), Zagreb.

Body Navigation [5], by Ole Kristensen, is an interesting example of interactive art. During this modern dance performance, a virtual background is projected onto the scene. This technique is not by any means new but the real interest lies in the nature of what is projected. In this piece, the set follows the dancers' movements, sometimes to circle them with light or draw their silhouette, sometimes to tie them to virtual ropes. One could imagine that this astonishing synchronization is the result of hours of repetition but it is actually the decor that adapt to the performers and not the other way. Thanks to Processing, the decor is dynamically generated during the live performance. Each representation is unique since the dancers control the set and the computer in charge of drawing the projection can take several random properties into account. In this case, it is the artists who interact with their environment in order to offer a new experience at each rendition. Dancers can completely improvise if they desire to, as they are no longer restrained by a static and motionless setting.

2.2 Giving full control to the audience: artistic gaming

As interactivity becomes a major component of contemporary art forms, we have to think about the true roles of both the artist and its audience. With varying degrees of controls over the art pieces, audience members are more than ever in charge of the outcome of a rendition whilst artists conceive, build and then let others explore their work. The pinnacle of this new relationship between the artist and its crowd is the emergence of a new art genre: artistic video game.

Video games evolved rapidly for the last twenty years. From Pong to modern productions, technical, creative and economic stakes have fully transformed. While it is highly debatable that some video games could be considered art or not, in the same way that not every movie is an art piece, the United States Government regards video games as a form of art and grants it federal funds since 2011 [2]. Nonetheless the acceptance of a video game as a work of art is not short of detractors, mainly because even if some productions show uniqueness and leak creativity, the quality in this medium varies a lot. Let us put this debate aside and focus on an explicitely artistic niche of the video game industry.

Art game began when curious players tried to modify their favorite games by fiddling with their source code and assets. This way they could change the apparences and behaviors of some game elements. Several studios fostered this trend by releasing game editors alongside their product. As players could enhance the original game and extend its lifespan, game makers were allowing them to explore new creative directions. Even if at its start, the modding scene was limited to game enthusiasts, artists quickly understood the power of this stuttering medium. Video games are very versatile: they can embed music and visuals, they can describe precise environments or to the contrary abstract worlds, but more than anything else they let the player take the control. This point is really crucial as never before a narrative art form has been interative to that degree. Movie-goers cannot influence the outcome of a picture, no matter how many times they watch it. With video games, viewers have the freedom to explore a world directly out of an artist's head and they can even interact with it. The use of video game as a support for art also has psychological benefits since a player is easier to reach emotionnaly when projecting himself onto a virtual

character [3]. With the boost in technology that led the videogame industry to its present state, virtual environments can be filled with vivid details in order to reinforce the global realism, thus a more immersing play is guaranteed.

One example of artistic video game is *The Graveyard*, by *Tale of Tales* [4]. In this game, the role of the player is to control an elderly woman visiting a cemetary. His field of action is quite narrow : he can only walk through the alleys and sit on a bench in order to launch a sequence in which the lady reminisces her past friends. As this unusual setting implies, this game is not supposed to be fun nor challenging and there is actually few similarities between a traditional game and *The Graveyard*, apart from the common medium and the mechanics of controlling a virtual character. Its ambition is rather to provide the player with an unexpected emotional experience. Players do not only feel empathy toward the old character, it's much more than that since the heavy atmosphere and general tardiness of this game let them catch a glimpse of the daily burden borne by a diminished person. Of course this remains a short experience, free of any consequences, and as soon as the member of the audience puts away the game controller his normal life goes on, but not without having been provided with food for thought.

Figure 6: Jason Rohrer, *Passage* (2007)

Jason Rohrer also chose the topics of time, life and death when making *Passage* in 2007 [1] . In this short two-dimensional game, the more the player goes forward (to the right of the screen), the more points he will score. This rule comes with a twist though, since the more he goes forward and the more he will age. Indeed, the character that is controlled by the player starts this five-minutes journey as a young boy and ends it as an old man, eventually dying. Contrary to *The Graveyard*, which puts distance between common games and itself, *Passage* contains a lot of typical game elements : notably obstacles to avoid and mazes to cross. And despite its æsthetic ressemblance with old games,

Passage is presented in an unusual format as the game area does not fill the entire computer screen like any others would and is confined to a thin strip of pixels, maybe to evoke the mental image of the corridor of life. Its uncanny scenario confronts the player with a choice : will he choose to go forward to achieve a high score at the risk of aging or will he prefer to stay behind and live forever? Curious players will be torn between these two possibilities and the only way to know which is best is to try them both. He here has a unique opportunity to live this adventure as he wishes, several times, each one with a different perspective.

Conclusion

Merwan olympi deus est.

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