The Artist and Advanced Technology

Frank Popper, Tim Fox

Leonardo, Volume 28, Number 1, February 1995, pp. 27-33 (Article)

Published by The MIT Press

THEORETICAL PERSPECTIVE

The Artist and Advanced Technology

Frank Popper

ABSTRACT

Positing that an artist is someone who chooses and pursues with perseverance an aesthetic goal, the author discusses various artists using advanced technologies. He holds that their use facilitates both the strengthening of their creative powers and their social integration. He concludes that belonging to an artistic trend linked to the ideas of the time is indispensable both for being recognized and for defining oneself as an artist.

What is an artist? Perhaps it is rather bold of me to try and answer the question straight out. Yet let me at least make a suggestion: being an artist is to choose and pursue an aesthetic end with a certain perseverance. This is that makes a man or woman become and remain an artist.

It must nonetheless be said that a good number of artists do not allow themselves to pursue aesthetic goals actively, arguing that their creativity is spontaneous—neither calculated nor thought out rationally. This objection is often heard from all sorts of artists but is clearly not shared by artists using advanced technologies, especially those who produce calculated computer-generated images.

What is characteristic about technological art is, in fact, the emergence of much closer ties between aesthetic and technical factors, as well as new notions in aesthetics that can be categorized as dematerialization, simulation, artificial intelligence, the environment, virtual reality and interactivity.

I would like to add that the aesthetic categories of artistic creation at the end of the twentieth century are highly varied and that the different aesthetic systems worked out by theoreticians—such as Thomas Munro, Kate Hevner, Etienne Souriau, Charles Lalo and Raymond Bayer—deserve updating in order to consider the use of advanced technology in artworks and creative procedures.

Let us assume that an artist using advanced technology is someone who is not only consciously or unconsciously pursuing an aesthetic goal with a certain perseverance but that he or she is also choosing to give preference to rational thought and mathematical calculation.

It should be mentioned, however, that among artists using advanced technology, a good number use it in a wild or deviant way. In these cases, the use of technology is intended to be an ironic, harsh criticism of scientific thought, and sometimes it is even an attempt to realize metaphysical designs.

If I have chosen here to concentrate primarily on artists who favor the aesthetic values of advanced technology, it is not

Frank Popper (theorist), 6, rue du Marché Saint-Honoré, 75001 Paris, France.

Translated by Tim Fox.

Received 7 December 1993.

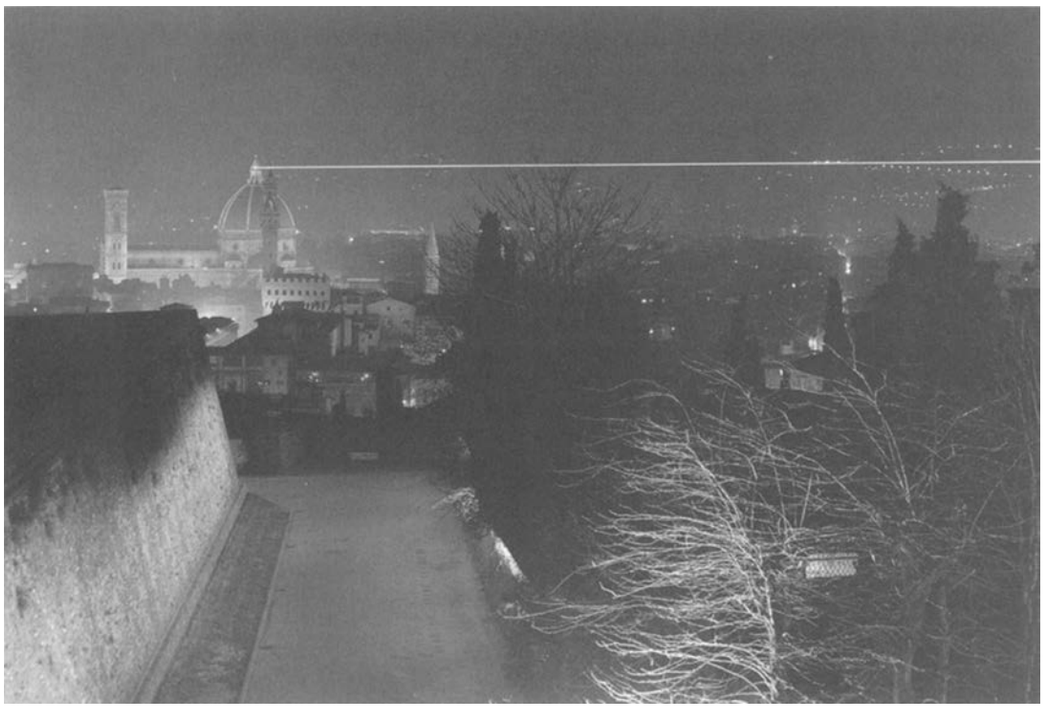


Fig. 1. Dani Karavan, *Environment for Peace: A Tribute to Galileo*, Florence, 1978. (Photo: Peter Czmuk) A long-distance argon-laser display symbolically joins the Bellevue Fort in the suburbs of Florence to the cupola of the Duomo.

only because I believe myself closer to them because of my previous work (kinetic, environmental and interactive art) but also because I want to highlight more directly the aspects of a deep mutation of civilization that seem linked to the advent of advanced technologies in all material and spiritual spheres of our lives and that, without doubt, affect artistic creation.

I would like to discuss a few artists who, in my mind, are among the most interesting cases. Each is a representative of the main advanced categories of technology—i.e. laser, holography, video, computer-generation, telecommunications and techno-ecology.

DANI KARAVAN: LASER ART

To have a better picture of the personality of Israeli sculptor Dani Karavan, who began using the laser in his plastic research in 1978, one should know that he was born in 1930 in Tel Aviv, where his father was a town engineer and planner. Karavan therefore spent his entire childhood at a constantly evolving site. The conquest by the town of the desert is a phenomenon that marked his imagination and sensibilities forever.

After his art training in Tel Aviv and Jerusalem, Karavan went to Florence in 1956 to study fresco techniques. Back in Israel in 1957, he tended towards integrating two-dimensional murals with architecture. In 1963, he opened a new era in his work with a minimalist, conceptualist sculpture of monumental and symbolic bent entitled *Monument to Life.* It was created near Beersheba in the Negev Desert.

The laser became part of Karavan's artistic repertoire towards the end of the 1970s, although he had become familiar with the technique and its aesthetic possibilities previously, both when he collaborated with the Czech scenographist Josef Svoboda and when he conducted research at the Massachusetts Institute of Technology in the United States and at the Weizmann Institute in Israel. The laser became an official part of his work in 1978 at a spectacular demonstration entitled *Environment for Peace: A Tribute to Galileo* (Fig. 1). In this work, a highly powerful laser symbolically joins Sangallo's *The Belvedere Fort* in the suburbs of Florence to the cupola of Brunelleschi's Duomo. In 1983, Karavan executed another environmental work entitled *The Bridge,* which linked the left and right banks of the Neckar River with a laser beam extending between the castle standing over the town and the trail on the other side known as the *Philosophers' Walk.* That same year, at the Electra exhibition in Paris, he used two vivid green laser beams to join the city's Museum of Modern Art, where the exhibition was being held, with the nearby Eiffel Tower and the district known as La Défense. This event was an attempt at making relationships tangible between historical and modern events and between architectural and technological creations, as well as to illustrate the mutation of the mechanical era into that of electronics.

At present, Karavan, ever faithful to the laser, is developing an urban project in the new town of Cergy-Pontoise. A laser beam will follow the town's main street to serve as both a directional signpost and decoration. But it is meant to be projected much further in order to symbolically link Cergy-Pontoise with one of the leading districts of Paris, the Etoile, without forgetting the historic monuments, such as Versailles, along the way.

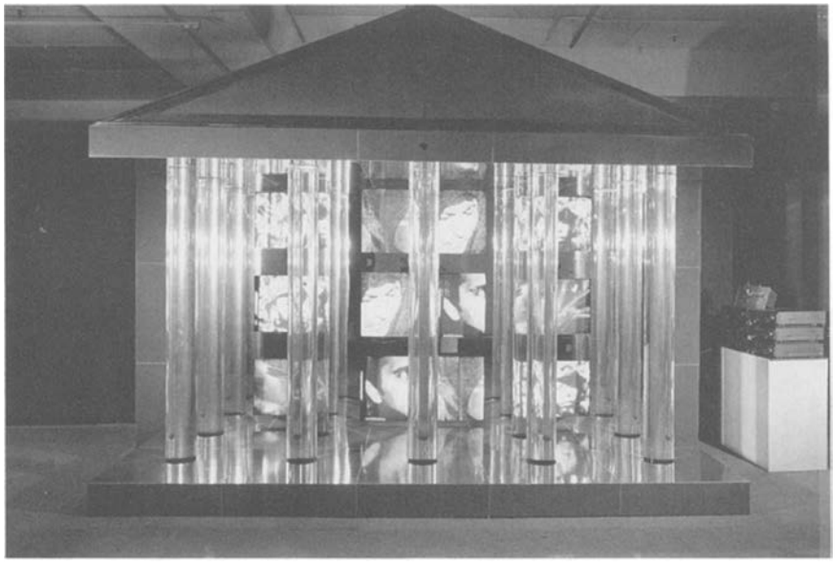
To better understand this artist's sociopsychological commitment, let us refer to Theodor Adorno and his aesthetic theories. For Adorno, art is neither a reflection of reality nor an aspect of ideology, as various dogmatists would have it. Rather, it is a witness to history—the accumulated experiences and suffering, as well as a manifestation of desire. Art is therefore the ferment and promise of a free world.

From the beginning of his artistic career, Karavan has never wavered in his socio-aesthetic position. His attempts to conquer space are linked to a veritable solidarity with his fellow citizens. His research has always leaned toward socially oriented urban planning. This has enabled him to be accepted as both artist and individual without distancing himself from his immediate entourage or from those he meets when carrying out a work in other countries.

The introduction of advanced technology in his work not only represents a possible transcending of human limits, it testifies to a firm determination on his part to be of his time by assuming the restrictions and implications of cultural circumstances.

Karavan is a good example of an artist whose penchant for mystical exaggeration is compensated for by a social and aesthetical commitment *hic et nunc.*

Fig. 2. Katsuhiro Yamaguchi, *La invención de Morel* (The Invention of Morel), 12 monitors, 6 video recorders, 3,180 × 4,000 × 2,270 mm, 1991. (Photo: Sadamu Saito) Allusion is made to Adolfo Bioy Casarel's novel with the same title, in which the hero discovers that the woman he as fallen in love with is nothing but an image produced by a machine, invented by the scientist Morel, capable of creating images with a soul.



DIETER JUNG: HOLOGRAPHY

With German artist Dieter Jung, one of the pioneers of holographic art, a transcendental penchant goes along with a solid knowledge of theology.

Jung, in fact, studied theology at Berlin's Kirchliche Hochschule in the 1960s while frequenting that city's art school. The blend of plastic arts and

theology played an important role in his work when holography was introduced. In 1972, he had been highly impressed by the religious tapestries at the Florence Cathedral Museum, which depicted scenes from the life of Saint John the Baptist based on drawings by Antonio Pollaiuolo. The system underpinning the fabrication of these tapestries, composed of thousands of interwoven threads, would be adopted by Jung for his future pictorial research.

Once he had definitively renounced theology in favor of the plastic arts (as did Van Gogh and Mondrian), Jung painted a series of portraits on canvas composed of crossing vertical and horizontal lines, the resulting "grid" of which reveals the warp and woof of the canvas.

There followed a series of collage paintings created of bird feathers—the structure, texture and color-range of which refract and reflect light especially well by creating iridescent optical illusions [1].

One of Jung's first large-scale holographic stereograms, carried out with the help of scientist Donald White, consists of a transposed poem by Hans Magnus Enzensberger called *Hologram*, specially composed for Jung. The poem begins with the words, "It is easy to build a poem in the air. All you need are a few well-lit words, light-footed, light-fingered, light-minded words." Thoughts on the fragility and transience of human existence follow. Another poem/text by Enzensberger, *Horizontal Symmetric* (Color Plate B No. 1), was transposed by Jung in such a way as to organize the horizontal and symmetrically arranged letters BIBI BEI BOP with computer-generated integral techniques.

In his holographic works, Jung seeks to combine the visual knowledge acquired in his work as a traditional painter with his more recent holographic experience so as to explore the new medium's aesthetic potential. His goal is to stimulate spatial imagination, generate new mental images and visualize a feeling of spatial fusion. However, holography is not only an exploration of the space and illusion of a fairly hallucinatory third dimension, it is also a new exploration of light's aesthetic qualities. It is on this level that Jung's theological studies combine with his former plastic work and his advanced technological studies. Here, again, holography as an advanced technology plays the role of sharpener and catalyst for aesthetic choices made by the artist, whose wide-ranging competence has been extended these past few years by his teaching activity at the new Hochschule für Medien of Cologne.

Fig. 3. Fred Forest, *Kunstland* (Land of the Arts), interactive video and telephonic network installation at the Exhibition Space "Kulturfabrik," Koblenz, Germany, 1984.

KATSUHIRO YAMAGUCHI: VIDEO

The theme of the teaching activities of artists leads me to examine the case of a Japanese video artist, Katsuhiro Yamaguchi, who is also an organizer of exhibitions in Japan and an educator at Tsukuba University.

Yamaguchi was born in 1928 in Tokyo. In 1948, he founded a group of abstract painters and sculptors. In 1949, he introduced electric light for the first time in his works after having been strongly influenced by reading the books of László Moholy-Nagy (*Vision in Motion* and *New Vision*).

Afterwards, Yamaguchi's research carried him from work on the optical effects created through graduated colors using acrylic paint to luminous moving works and, finally, to large-scale videographic environments.

In the 1970s, Yamaguchi showed interest in the relationships between electronics and art, as well as a predilection for teamwork, by participating in groups of artists using computers and video as well as traditional media, while continuing his own work.

On the video technique level, Yamaguchi has used two main modalities: production of videotapes and (especially) video sculptures and installations.

On the aesthetic level, he has, among other things, updated the themes of traditional Japanese culture in the fields of garden art and architecture. This can be seen in video sculptures such as *Future Garden* (1984), *Arch and Column* (1988) and *The Invention of Morel* (1991) (Fig. 2). These electronic works on a screen, according to Yamaguchi, take on an exceptional power when they are conceived for a real space in which they are effectively shown as videographic installation sculptures.

According to Yamaguchi, the history of art in the twentieth century is also that of individuals who have dreamed of utopia within society. With the development of advanced technology, artists are inclined to redefine this utopic dream. Some of them, by using technique as a tool, have proposed new creative methods. Others, according to Yamaguchi, do not yet have the technological means they would like but are waiting to use them for artistic ends.

To meet the demands of solo artists without much money, Yamaguchi has built a special place on the Japanese island of Awaji—a center where artists can have access to all the devices indispensable to the creation of technological works. This center possesses, among other things, a library, a movie theater, a restaurant and an exhibition space. In short, the center evokes a technological *Paradiesgärtlein* (a small garden of technological paradise). Yamaguchi's confessed goal is to realize at last Charles Fourier's plan for "utopists of art and technology."

Fig. 4. Piero Gilardi, *Inverosimile*, Castello di Volpaia, Italy, 1990. This installation is divided into 20-minute programmed cycles that simulate light conditions during a day from dawn to sunset. The spectator circulates between three rows of artificial vines that react through sound and light to his movements.

HERVÉ HUITRIC: COMPUTER ART

The atmosphere in the numerous university research centers in France, Germany and the United States that deal with the relationship between art, technology and science is perhaps not idyllic, but the researchers in these countries devote themselves to the visualization of the most hidden phenomena of our universe with the help of the latest developments in computer science.

I have chosen Hervé Huitric from the many artists using computers and other computer-related elements because he represents a good example of the blend of a sophisticated technician and a traditional artist. Moreover, his itinerary, which began with "elementary" plastic studies and, first of all, with color, has continued, as has that of many computer artists, with studies of the imitation and simulation of the reality of the human body. These studies have been done in close collaboration with other plastic artists and scientists, all members of a team working at the Université de Paris-VIII (Saint-Denis) and Paris-VII (Jussieu).

Huitric's two-fold training explains his "case." He was both a student at the French National School of Art and a computer student at the Université de Vincennes, where he eventually became a teacher. It enabled him to consider both technical and aesthetic problems as diverse as the computerization of facial expressions, vocal articulation, walking, dancing, jumping and even applause. These studies, based on the development of rigid or animated three-dimensional-image software with an artistic aim, are not restricted to simulating the prototype of a facial expression, the voice or body movements in general. They attempt to reproduce and recreate a large variety of these modalities. In order to give the greatest possible verisimilitude and liveliness to a face, Huitric and Monique Nahas, another scientist-*cum*-artist, have worked out a system of recording the texture and mobility of skin, which these two artists consider a representative element that has been too long neglected in the production of images.

According to Huitric and Nahas, while emotional expressions vary according to the culture to which each individual belongs, cultural belonging has no incidence on the play of muscles that are behind these different expressions. This explains why Huitric and Nahas have analyzed the most subtle changes in the face—i.e. the blinking of eyes, frowning, the pinching of the mouth, the creasing of cheeks, the dilation of pupils, etc. (Color Plate B No. 3).

On the aesthetic level, the Huitric-Nahas option favoring realistic representation and simulation is not shared by their team of colleagues. One of their closest collaborators, Michel Bret, has opted for an abstract or semi-abstract language in his computer-generated drawings, using, as does the rest of the team, the enormous technical possibilities placed at their disposal—i.e. animating the screen surface with a million individually controllable pixels and 16 million different colors. This team of artists working on computers is thereby ever more inclined to ignore the subject's physical characteristics in order to turn its attention more to the rules that enable the subject to appear and exist.

These artists consider that the computer is not merely a tool but a "meta-tool"—i.e. a tool serving to manufacture other tools. This means that certain "technological" artists no longer produce works but the procedures that engender them.

FRED FOREST: THE ART OF COMMUNICATION

Although there may be no doubt as to the artistic status of the creators mentioned above, it is useful to study the cases of technological artists who operate on the edges of the artistic field as such. Fred Forest is an example of this kind of artist. He devotes himself to what we might call the "art of communication." It is certain that here we are venturing fairly far from the idea we have of painters and sculptors of the past. In Forest's case, we can even say that art has left its traditional arena to enter that of media or advertizing.

Yet, a careful analysis of Forest's itinerary and activities shows us that he is a veritable artist; his options and behavior are those of a creator of the new values of an aesthetic order obtained through work in communications—provocative work, but sensitive nonetheless. This process is not illustrated by the production of tangible and physically realized objects but by the production of communications systems and diverse situations.

To grasp the meaning of the relationship between subjective and social factors in Forest's background, it should be noted that from 1954 to 1970 he was a postal and telecommunications Inspector in Algeria, which, as we see, influenced his artistic career for, at the same time, he was a painter. Both occupations ended in 1970 with a decisive step: postal employee Forest became a communications artist, inaugurating inventive and creative work in human networks and relations.

Such an existential transformation is not entirely miraculous. During the pe-

riod of 1968 to 1970, counterculture movements assimilated life with art and highlighted each person's daily creativity. Forest's existential transformation was also linked to the introduction of advanced technology in his art. He was among the first in France to use video and closed-circuit television. In 1970, he realized an audiovisual show at the Universal Exhibition of Osaka before directly interceding in the press and other mass media all over the world. His communications systems utilize telephone, radio, television, telematics and cable (Fig. 3).

Among his more general events, his *Sociological Walk* through the district of Brooklyn-São Paolo, Brazil (October 1973), is of particular interest. Through daily advertisements in local newspapers and on local radio urging the residents of Brooklyn-São Paolo to phone the Museum of Contemporary Art, São Paolo, to sign up for this event, Forest invited participants to walk with him through the district according to a pre-planned itinerary. At each stage, the group visited the local music shop, the fruit vendor, the cobbler, the bank, the supermarket, the church and an art gallery. Forest was aiming at investigating a localized urban area through its different business, administrative and cultural vocations. With the participants' help, he wanted to experience daily reality, reveal internal relationships and create microcommunication events, enabling the establishment of information-circulation through direct intervention in the milieu.

Forest's artistic career has also been marked by his belonging to the Sociological Art Collective, in which he was active until the end of the 1970s, then to the Communication Aesthetics Group. Each of these movements united plastic artists and theoreticians (sociologists and aesthetic thinkers) and gave them the chance to show their work individually as practicing artists after attempting to work out a common theory.

Forest has recently devoted himself to producing electronic-diode newspapers that unite two characteristics of his procedure: limited appearances in the mass media and the use of advanced technology. One of his latest works of this type, *The Bible Culled from the Sands* (originally called *The Electronic Bible and the Gulf War*), shows a luminous parade of quotes from the Old Testament simultaneously with excerpts of newspaper articles reporting the fighting in the Persian Gulf War. As in citation painting, long lists of military equipment are juxtaposed with long genealogies taken from the Bible.

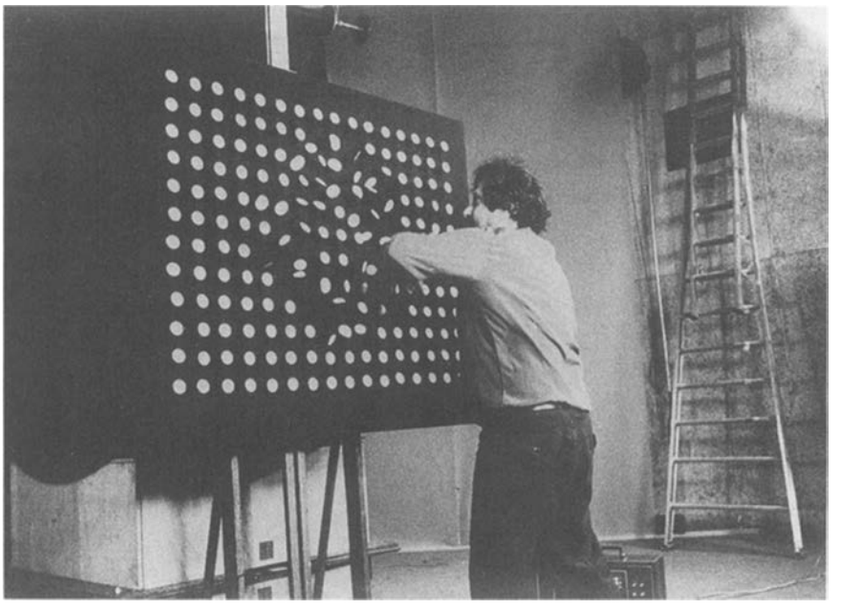


Fig. 5. Yaacov Agam, *Image sonore II* (Sonorous Image II), stainless steel on wood, with incorporated resonance box and polished metal elements attached to metal springs, 39 × 55 in, 1963. (Photo: J.M. Chourgnoz) This sonorous tactile picture emits varying sound as its structure is transformed by the viewer.

Forest thereby attempts to draw our attention to the fact that history can repeat itself through similar speeches. He obviously does not care about stereotypical statements made by politicians and military leaders. All of Forest's socio-political manifestations are provocative and critical by nature, but they incite one to think—even if they grate because of their aggressiveness. In the end, they work as questions, communications and interactivity that confirm Forest's artistic aims. The basically solitary nature of his artwork can thus be attenuated by the possibility of forming intense relationships with those people he meets at the events created by him.

We can see in Forest's procedure many aesthetic aspects linked to the question of interactivity and human relationships, but I would rather illustrate them with the help of a new procedure, that by Piero Gilardi, a "techno-ecological" artist.

PIERO GILARDI: TECHNO-ECOLOGY

Born in Turin in 1942, Gilardi is concerned about reconciling apparently irreconcilable terms such as "nature" and "technique" (or "ecology" and "technology"). This concern was already visible at the beginning of the 1960s in his first sculptural phase, in which he produced what he calls his *Tappeti-natura*. The "natural carpet" is a rectangular block of polyurethane covered by a rubbery crust that looks as though it were cut out of a forest, a river bed or a pebble beach. In short, a piece more real than nature but not realistic. This means an ecological awareness before its time that took the form of humor, fiction and, especially, artistic creation. A little later he extended his "natural carpets" to environmental dimensions directly in the landscape.

This phase of countryside creations was followed by a phase entirely devoted to the theoretical analysis of the new tendencies of the late 1960s and early 1970s: Land Art, Arte povera and Antiform, as well as aesthetic-political events in Third World countries.

It was around 1985 that Gilardi resumed his plastic activities after an excursion into therapeutic art as a consultant at different Italian psychiatric hospitals. He introduced advanced technology in his procedure for realizing a technological megasculpture project entitled *Ixiana*, which was to take the form of a gigantic "bionic doll," on the inside of which visitors would be able to exercise their creativity on interactive equipment involving the use of the body and the senses. The project was never carried out because of its cost, but Gilardi continues his work in the same direction, especially with an installation called *Inverosimile* (Unlikely) (Fig. 4), in which the spectator can circulate between three rows of artificial vines that react to his or her movements.

Like other artists of this tendency interested in techno-ecology—e.g. Jürgen Claus and his sun sculptures or Otto Piene and his Sky Art—Gilardi highlights the irreplaceable qualities of our environment by using natural forces as models and advanced technology to bring out the strength of artistic expression. Whether a matter of simulation or a re-creation of natural elements, or a combination between natural and artificial factors, Gilardi's work, like that of most techno-ecological and indeed many high-tech artists, is ever an attempt to reconcile two apparently contradictory terms: scientific or technological progress against biological and spiritual survival for mankind.

YAACOV AGAM: THE TECHNOLOGICAL EXTENSIONS OF KINETIC ART

This same problem impregnates Yaacov Agam's processes. This artist is of special interest because he is a pioneer of kinetic art who has never given up experimenting with the help of diverse means—including those offered by all the advanced technologies. He might be described as a "brilliant dabbler." In fact, he is an artist who has pursued a logical career ever since he found his calling shortly after his arrival in Paris in 1951.

Yaacov Gipstein, as he was previously known, was born in Israel in 1928 to a rabbi father. He adopted his mother's maiden name (as had Picasso) to mark his departure and, from then on, signed his paintings with the name Agam. Defining his personality in just a few words is not easy. On first sight he appears narcissistic. In opposition to this character trait—perhaps necessary in all artists whose processes require great perseverance and total focus on the goal they wish to attain—one can see Agam's desire to deeply implicate the public in his works throughout his entire career.

His religious spirituality contradicts his enthusiasm for the constructivist-abstract, rationalist, social and universalist ideas and practices of the Bauhaus masters. It is true that among these there were a few mystical characters, such as Johannes Itten, who was in fact one of Agam's teachers before his arrival in Paris.

The key to Agam's art, it seems to me, is in his determination to transcend two types of opposition: on the one hand, between the individual and society and, on the other, between spiritualism and rationalism or, indeed, between metaphysics and rational logic.

The opposition of individual and society (does the artist create for the public or does he only follow his own creative urge?) is at the heart of the new relationship between public participation and the artist's responsibility. This relationship began with kinetics and continues in telecommunications art and computer art—developments that have been followed by Agam in his works—and also in virtual environments.

With Agam we might wonder if this participation is calculated by the artist—which would give a limited choice to the spectator—or if, on the contrary, the notion of participation resides in the equality of two sensibilities: that of the artist and that of the spectator. Is this invitation to participate a situation in which the spectator reinvents art? Does it incite spectators to become actors by using all their senses and considering several temporal and dramatic factors? Or is it meant to make the spectator experience freedom? This last hypothesis seems to me the most likely.

To reconcile his metaphysical and rational penchants, Agam practices in his work what I would call "the presence of the invisible," or "the perceptible absence of the image." This "inspired" procedure is, of course, to be joined with the artist's determination to conform to the Bible's teachings and, especially, to the second Commandment, which prohibits the idolatry of graven images. Agam draws his inspiration from the Talmud, the reading of which is essentially an experience that transcends the limits of logical and rational thought.

Agam has applied this aesthetic-religious approach for nearly 40 years through polymorphic paintings, play objects, transformable sculptures, videographic and holographic works and, finally, through works with effective and multidirectional movements—in order to try and create another reality made visible by the works' multiple metamorphoses (Fig. 5).

But Agam's main contribution to the art of advanced technology consists of a series of mobile, graphic and chromatic compositions of an abstract geometric style permutated by computer and simultaneously broadcast on some 15 video monitors. One of these series is called *Visual Music Orchestration.* The artist tries to test the spectator's visual capacities and to have him or her discover the entire recent past of optical art, for example, from Joseph Albers's well-known *Tribute to the Square.* Here we experience a return in time, which occurs frequently in the painting of the 1980s and which also occurs in technological art.

However, the introduction of advanced technology in Agam's art is only a phase in his quest for the absolute, to fulfill both his need for spirituality and his determination to share the creative act with the public.

CONCLUSION

The introduction of advanced technology into the creative processes of the artists and works I have discussed responds both to their individual ambitions of a psychological order and to their desire for social acceptance.

On the one hand, high-performance tools that allow the greatest possible choice of forms and colors have been placed at their disposal, favoring better control of the spatial and temporal parameters of their work. The abilities of these artists to exercise their creative powers are amplified—a situation that can only reassure their artistic personalities.

On the other hand, it is certain that artists using advanced technologies derive great satisfaction and fine existential stimulus from manipulating abstract information both mentally and manually (this is especially true of computer artists). The manipulation of abstract data can lead not only to the inception of virtual reality in a cybernetic space but also to the realization of even more utopian and metaphysical goals.

As for the influence on a social level of artists' adopting advanced technology, we have seen in some cases the role it can play—e.g. by de facto opposition to the artist's traditional solitude. A number of artists have in fact chosen to work in teams in high-tech laboratories that would be impossible to set up and maintain by oneself. Yet insofar as we are witnessing a greater miniaturization of all technological systems (again, especially, the computer), it is no longer so difficult to obtain or install them at home, which could well return the artist to traditional isolation if he or she does not take advantage of the development of telecommunications networks.

In any case it is clear that for technological artists—as for all artists in general—a happy blend of solitary and collective creation, or the solitude needed for conception and confrontation time with other creators and/or the public, represents a vital necessity. What I find

perhaps most successful with technological artists is the passage from one of these modalities to the other and a flexible coming and going between the psychological and the sociological. With artists using advanced technologies, there is necessarily a greater need to compare one's aesthetic choices with those of the other players on the artistic scene but also to compare the condition on a day-to-day basis of one's technical system with the whole of the constantly developing technological field.

Being an artist, feeling like one and being recognized as one depends then, as we have seen, not only on psychological and sociological factors but also on aesthetic factors.

We must not underestimate the fact that the pursuit of aesthetic ends—such as the visualization of hidden phenomena in the universe, the highlighting of new temporal and spatial aspects or the establishment of new relationships between artist/art/spectator through interactive procedures—by ever more artists throughout the world has as a consequence the formation of a clearly definable artistic tendency or current that may be called technological art or techno-scientific art [2].

References and Notes

1. I would like to mention in passing that iridescence is an aesthetic theme introduced in 1912 by Giacomo Balla in a series of abstract paintings—some of the genre's first—made of interlinked rainbow-colored circles. These paintings are one of the sources of what in the 1960s and 1970s was called Optical (Op) Art. Balla talked about "the iridescent beauty" of his compositions, while Jung speaks of "fractal beauty" to qualify his holographic production.

2. For a more detailed discussion of technological art, I refer the reader to my latest book, entitled *Art of the Electronic Age*, which includes the following:
   1. A review of art forms involving advanced technology and discussions of the artists active in these fields.
   2. A study of the technical and aesthetic factors in laser art, holographic art, video art, computer art, telecommunications art, techno-ecological art and, especially, the aesthetic intentions of the artists, admitted or otherwise.
   3. A determination of aesthetic factors that might be applied to all of these art forms and therefore to the overall phenomenon that might be loosely categorized as technological art.

   In the conclusion, I sum up the various aesthetic categories that may be linked to the notions of artificial intelligence, simulation and interactivity but that also deal with the often-prospective themes of visualization, multi-sensoriality, cultural mediation and double creativity (artistic and scientific) as well as the relationships between the creative process and the finished work and between reality and virtuality.

   I have tried as well to determine the place of contemporary technological art in relation to modernism and post-modernism by examining certain characteristics of each that are present in the technological art of our time.

Bibliography

Forest, F. Art sociologique (Paris: Union Générale d'Editions, 1977).

Jencks, C. *What Is Post-Modernism?* (London: Academy Editions, 1986).

Jimenez, M. *Adorno: Art, idéologie et théorie de l'art* (Paris: Union Générale d'Editions, 1973).

Popper, F. *Agam*, 4th Ed. (New York: Abrams, 1976/1990).

Popper, F. *Art of the Electronic Age* (London: Thames and Hudson; New York: Abrams, 1993).

Restany, P. *Dani Karavan* (Munich: Prestel, 1992).

Aesthetik des Immateriellen, Kunstforum International, No. 97 (November/December 1988) and *Kunst und die neuen Technologien, Kunstforum International,* No. 98 (January/February 1989).

Leonardo Special Issues: *Electronic Art* (1988); *Computer Art in Context* (1989); *Holography as an Art Medium* (1989); and *Connectivity: Art and Interactive Telecommunications* (1991).

Nouvelles Technologies, Special Ed. (Paris: Art Press, 1991).