Some considerations on Interactive Art

Sección central

Artículo de reflexión

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Algunas consideraciones del arte interactivo

Resumen

Este artículo explora prácticas dentro del campo del arte y la tecnología que se centran en la interactividad, en particular, arte interactivo. Examinamos conceptos clave relevantes para el arte interactivo, como el papel del interactor, la estética interactiva, el carácter lúdico y la arquitectura relacional, entre otros elementos. Para ello, consideramos las obras interactivas de artistas como Maurice Benayoun, Studio Azzurro, Marcel·lí Antunez Roca y Rafael Lozano-Hemmer. Además, cuestionamos la definición de "arte interactivo" a la luz de las tecnologías computacionales contemporáneas, en particular las que involucran inteligencia artificial. Buscamos contribuir al debate actual al impulsar la reflexión sobre el concepto de interactividad y su papel cambiante en respuesta a los avances tecnológicos actuales que abarcan una gama de sistemas diseñados para imitar las funciones cognitivas humanas. En última instancia, ofrecemos perspectivas sobre el arte interactivo, con el objetivo de contribuir a una comprensión más amplia de la interactividad en el arte y la tecnología como una experiencia sistémica, visual, tecnológica y estética.

Palabras clave

Arte; estética; arte interactivo; interactividad; tecnología; ciencia

Some Considerations on Interactive Art

Abstract

This article explores practices within the field of Art and Technology that focus on interactivity, in particular, interactive art. We examine key concepts relevant to interactive art, such as the role of the interactor, interactive aesthetics, playfulness, and relational architecture, among other elements. In doing so, we consider the interactive works of artists such as Maurice Benayoun, Studio Azzurro, Marcel·lí Antunez Roca, and Rafael Lozano-Hemmer. Additionally, we question the definition of "interactive art" in light of contemporary computational technologies, particularly those involving artificial intelligence. We seek to contribute to the current debate by prompting reflection on the concept of interactivity and its evolving role in response to current technological advancements that encompass a range of systems designed to mimic human cognitive functions. Ultimately, we offer insights on interactive art, aiming to contribute to a broader understanding of interactivity in art and technology as a systemic, visual, technological, and aesthetic experience.

Keywords

Art; aesthetic; interactive art; interactivity; technology; science

Quelques considérations sur l'art interactif

Résumé

Cet article explore les pratiques dans le domaine de l'art et de la technologie qui mettent l'accent sur l'interactivité, en particulier l'art interactif. Nous examinons les concepts clés pertinents à l'art interactif, tels que le rôle de l'interacteur, l'esthétique interactive, le jeu et l'architecture relationnelle, entre autres éléments. Pour ce faire, nous considérons les œuvres interactives d'artistes tels que Maurice Benayoun, Studio Azzurro, Marcel·lí Antunez Roca et Rafael Lozano-Hemmer. De plus, nous nous interrogeons sur la définition de « l'art interactif » à la lumière des technologies informatiques contemporaines, en particulier celles impliquant l'intelligence artificielle. Nous cherchons à contribuer au débat actuel en suscitant une réflexion sur le concept d'interactivité et son rôle changeant en réponse aux avancées technologiques actuelles qui englobent une gamme de systèmes conçus pour imiter les fonctions cognitives humaines. En fin de compte, nous offrons des perspectives sur l'art interactif, dans le but de contribuer à une compréhension plus large de l'interactivité dans l'art et la technologie en tant qu'expérience systémique, visuelle, technologique et esthétique.

Mots clés

Art ; esthétique ; l'art interactif ; interactivité ; Technologie ; science

Algumas considerações sobre arte interativa

Resumo

Este artigo explora práticas no campo da arte e da tecnologia que se concentram na interatividade, em particular, na arte interativa. Examinamos conceitos-chave relevantes para a arte interativa, como o papel do interagente, a estética interativa, a ludicidade e a arquitetura relacional, entre outros elementos. Para isso, consideramos as obras interativas de artistas como Maurice Benayoun, Studio Azzurro, Marcel·lí Antunez Roca e Rafael Lozano-Hemmer. Além disso, questionamos a definição de "arte interativa" à luz das tecnologias computacionais contemporâneas, particularmente aquelas que envolvem inteligência artificial. Procuramos contribuir para o debate atual, impulsionando a reflexão sobre o conceito de interatividade e seu papel mutável em resposta aos avanços tecnológicos atuais que abrangem uma variedade de sistemas projetados para imitar as funções cognitivas humanas. Em última análise, oferecemos perspectivas sobre a arte interativa,

com o objetivo de contribuir para uma compreensão mais ampla da interatividade na arte e na tecnologia como uma experiência sistêmica, visual, tecnológica e estética.

Palavras-chave
Arte; estética; arte interativa; interatividade; Tecnologia; ciência

Sug kawaikuna kai ruraikunata katichinakuskata

Maillallachiska
Kai mailla kilkaskapi kawachinakum imasam ruraikunata ñugpata apamunakuska, chasallata kai sugrigta kunaura tukuska. Kawanakum kai kilkaska tiaskata kai runakuna Marice Benayoun, Studio Azzurro, Marcel li Antonez Roca i Rafael Lozano Hammer paikuna tapuchirinakum imam ka " ruraikunata kawai" imasam kunaura ruranaku tiam kunaura sug computador kunapi kawaspalla nukanchi runakusina iuaspa rimachingapa chi nispa kaipi ninakum kama jai ministidu kawanga allilla imasam katichinakunchi, kai ruraikunata chasa iukanchimi kawanga allilla kai kimsa ruraikuna. Kawai. Apachii, allilla rurai. samunakuskata iachachisunchi mana tukuiruchu kausaikuna i Nukanchipa rimai.

Rimangapa ministidukuna
Ruraikuna; sumaglla kawachii; chapu kawachii; sugkunawa parlai; tecnología; kausaikuna

In considering interactivity within the contemporary context of art practices and reception, it is important to note that interactivity is not exclusively linked to Art and Technology; it has been a fundamental aspect of the arts and human relationships long before modern technologies emerged. As Mulder explains, "Interactivity is a concept, a way of working; it is not tied to specific technologies or machines. It can be achieved in any medium" (Mulder, 2010, p. 31). However, with the incorporation of digital devices in art and the acceleration of computation, interactivity has become foregrounded as a pivotal and determinant issue, re-referencing human-machine, machine-machine, and human-human relationships.

The science of Cybernetics, established by mathematician Norbert Wiener in 1947 (George, 1979), takes an interdisciplinary approach to understanding the dynamics of systems and feedback processes in human-machine communication. Artificial intelligence (AI), initially explored by Alan Turing, developed further in the 1950s through the work of Marvin Minsky, John McCarthy, Herbert Simon, and Allen Newell, leading to a new field focused on machine intelligence (Nilsson, 2010; Bates, 2024). In the 1960s, computer scientist Licklider Sutherland studied the human-computer relationship, which laid the groundwork for interdisciplinary studies in Human-Computer Interaction (HCI), formalised in 1983 by Donald Norman (1986), who introduced the concept of usability—a focus that persists today (Turner, 2023). The integration of computers into daily life began with the rise of personal computers in the 1970s, laptops in the 1980s, and internet-enabled mobile devices in the 1990s, making devices more portable and akin to extensions of the human body (McLuhan, 1994), providing constant online access. Today, with advancements like virtual reality, the metaverse, Large Language Models (LLMs) and various generative AI (GAI) platforms and virtual agents of all types, interactivity has become an integral part of everyday life. While interactivity is now imperative, it remains neither absolute nor neutral.

This article aims to explore the processes of interactivity within the field of art and technology, focusing on computational practices that emphasise interactivity, commonly referred to as interactive art. We examine interactive art by discussing key concepts such as the interactor, interactive aesthetics, playfulness, and relational architecture, among others. By providing a brief overview of interactive proposals, we highlight the artistic contributions of figures such as Maurice Benayoun, Studio Azzuro, Marcel·lí Antúnez Roca, and Rafael Lozano-Hemmer, among others. Finally, we question the relevance of the term "interactive art" in the context of modern computational technologies, particularly artificial intelligence, which necessitates both voluntary and involuntary interaction. In doing so, we offer reflections on interactive art and aim to expand the understanding of interactivity in art and technology as a systemic, visual, technological, and aesthetic experience.

Interactive art and interactivity

The term Interactive Art emerged in the 1990s with the interactive installation *Videoplace*, by Myron Krueger[1], recognized as the first work of "interactive computer art as a composition medium" (Popper, 2007, p. 182). *Videoplace* is an interactive installation that responds to the movements and actions of interactors in separate rooms, communicating via technology through real-time silhouette video capture.

From an interactive paradigm, we understand that proposals in interactive art focus on action: "Interactive art is not visual art, but action" (Brouwer & Mulder, 2007, p. 52), where artistic proposal and interactor mutually modify each other in the same techno-aesthetic experience. Digital media art incorporates a systemic view, in which the artwork and interactor cannot be seen separately (Arantes, 2005), as the artwork is constituted in the interactor's action. Thus, the field of interactive art focuses on interactivity mediated by computational technologies, where artistic production arises from the relationship between artwork and interactor.

Interactive works are created and evolve throughout the experience involving the artist,

1 Ver «https://aboutmyronkrueger.weebly.com/videoplace.html»

interactor, proposal, and medium, breaking free from the frame and demanding interaction, as it is fundamentally relational. Interaction does not always entail direct action; the mere presence of the interactor can itself be a form of interaction. The dialogue between the artistic proposal and the interactor is established not only through language or reflection but, more importantly, in a practical and intuitive way, following the circular nature of communication, which encourages the audience's engagement with the artwork (Giannetti, 2002). The focus is on this moment of encounter, or "real time," where both the artwork and the spectator undergo transformation, allowing for the observation of the effects the artwork has on the spectator and the impact the spectator has on the artwork.

When referring to interactive art, the spectator is referred to as an interactor, as stated by Arlindo Machado: "This active and immersed recipient, whom we will now start calling an *interactor*, since expressions such as *user, spectator, and recipient* no longer account for the new participatory situation" (Machado, 2007, p. 144, our translation, emphasis added). In interaction, there is action between the interactor and the artistic proposal, where even a simple movement by the interactor, or being present with their physiological changes, can lead to transformation.

The Brazilian artist and writer Júlio Plaza (1990) notes that, with Moholy Nagy's act of painting a picture over the telephone, a principle of interactivity occurred because it placed an element between the artist and the artwork. Júlio Plaza (1990) identifies three degrees of openness in the relationship between author-artwork-receiver, focusing on the public's participation in the construction of the artwork: the first is first-degree openness with passive participation, in which the public engages with the open work through their interpretations and multiple readings based on what the artwork evokes, referencing Marcel Duchamp, Umberto Eco, and Mikhail Bakhtin: "a fundamentally ambiguous message, a plurality of meanings in a single signifier" (Plaza, 1990, p. 11). Then, we have second-degree openness with active participation, in which the public explores, manipulates, and experiences the artwork, with reference to artists from the 1960s and 1970s with participatory works (such as *happenings* and performances) and theorists like John Dewey. Finally, third-degree openness with perceptual and interactive participation, in which the relationship between the public and an intelligent computational system occurs, involving telematic networks and artificial realities, leading to a transformation of the artwork and the audience. Thus, an interactive work of art is a latent space susceptible to all sound, visual, and textual extensions, where the public, as a co-author, becomes an interactor (Plaza, 1990).

> Active participation (for example, manipulation of the artistic object, intervention, modification of the artwork by the receiver), perceptual participation (kinetic art), and interactivity, as a reciprocal relationship between the user and the intelligent system. (Plaza, 1990, p. 10)

When talking about new media, Lev Manovich points out that

> New media is interactive. In contrast to traditional media where the order of presentation was fixed, the user can now interact with a media object. In the process of interaction, the user can choose which elements to display or which paths to follow, thus generating a unique work. Thus, the user becomes the co-author of the work. (Manovich, 2006, p. 96)

The visual and auditory aspects of the artwork change not only through the interactor's perception but also within the artwork's own structure. From this standpoint, "every perception is already an action, so in fact in this sense, there is no art that is not interactive. But only art that presents itself as interactive tries to absorb this activity of the viewer and make itself open so that it, too, can change" (Brouwer & Mulder, 2007, p. 5). Interactive art, as an open form, seeks to provoke the interactor's engagement and explicitly highlight the perceptual relationship being formed. As "perception becomes action, and the action of perceiving adds something to the work. The act of perceiving thereby becomes the act of making the work" (Brouwer & Mulder, 2007, p. 5). Within the interaction between the system of artwork, interactor, and

medium, there emerges the potential to generate information—understood as the artwork's capacity to create disruptions and activate the ability to act. The focus has shifted from considering the artwork as an isolated entity to viewing it in terms of the interrelations and interconnections that shape it, mediated by computational technologies and activated by interactors within these spaces (Mondloch, 2010; Sommerer et al., 2008). These environments are seen as responsive, intelligent, and data-rich, prompting the need for investigations into interactive and connective processes. As Ascott explains, "for the connectivist, this is a question of creating an interactive art of intelligent systems set within intelligent environments" (Ascott, 2003, p. 337). Our interest lies in examining interactive environments that explicitly reveal the changes they cause and experience through interaction.

Considering "interactivity as a user's ability to manipulate and affect someone's experience through media" (Popper, 2007, p. 177), it is crucial to examine the types of interactivity offered by interactive environments. As Wood notes, "experiences can be productive and generate encounters, while others can disarticulate and reduce us to mere spectators of the system" (Wood, 2007, p. 161). Therefore, it is necessary to consider the "grammar of interaction" in an interactive environment (Simanowski, 2011), focusing on "describing and analysing the actions and the processes of perception and knowledge acquisition made possible through engagement with interactive media art" (Kwastek, 2013, p. 43) is essential, which involves investigating architectural and navigation models that explore interfaces and movement. One might argue that the strength of interactive art lies in its ability to illuminate the processes of interactivity occurring within the experience itself. In this context, interactivity enables alternative ways of navigating and assembling, with the potential for immediate intervention, going beyond a simple point, click, or singular response (Paul, 2003, p. 68).

This exploration of interactivity not only enriches the understanding of user engagement but also expands the potential for aesthetic experiences in digitally mediated environments, where new forms of hybridised aesthetics and machinic interactions emerge. Digitally mediated interactivity opens up new potential for aesthetic experiences (Kwastek, 2013). As Manovich indicates, "the result of the hybridisation process is not simply a mechanical sum of the previously existing parts but a new 'species'—a new kind of visual aesthetics that did not exist previously" (Manovich, 2015, p. 259). Andreas Broeckmann, in discussing Machine Art, asserts that an "aesthetics of the machinic" helps describe the aesthetic experience we may have, not only in the presence of an autonomously operating technical system but also in artworks that reinforce a logic of experience beyond our subjective control (Broeckmann, 2016).

Brief overview of interactive installations

The Franco-British art and technology historian Frank Popper (2007) notes that interactive digital installations exhibit a predominant techno-aesthetic category and have as their main theme the interaction with the spectator. Popper (2007) provides a historical overview of the early references in interactive art, including its origins in kinetic art: Moholy-Nagy, Bauhaus, Vasarely, Raphael Soto, Naum Gabo; in Dada: Duchamp, Hausmann, Fluxus, Allan Kaprow; in neoconstructivism: Lygia Clark, Helio Oiticica; in Pop art: Yves Klein, Andy Warhol, and Roy Lichtenstein.

He highlights several important contributions to the development of interactive installations, including works by artists such as Jean-Paul Longavesne, Roy Ascott, Kit Galloway, Derrick de Kerckhove, Jeffrey Shaw, Bill Seaman, Peter d'Agostino, Orlan, David Rokeby, Susan Collins, Luc Courchense, Richard Brown, Christa Sommer, Michel Chevalier, Shawn Briexey, among others. Myron Krueger[2] (1970) and Scott Fisher[3] (1995) with sensory immersion works; Char Davies[4] (1997) with interactive immersive environments aiming for a temporary collapse in the division between object and subject, interior and exterior, self and world, immersed in the flow of life through time and space, a research on non-Cartesian space and bodily perception, a perceptual

2 Ver «https://aboutmyronkrueger.weebly.com/metaplay.html»

3 Ver «http://www.itofisher.com/sfisher/»

4 Ver «https://www.immersence.com/»

experience; Simon Biggs[5] (1992) with experimental shadow art, questioning how we are mediated by language and technology; Toni Dove[6] combining the interactor's body with the structure of the story, creating projections of interactive narratives in the concept of an embodied interface that allows physical interaction with the film; Stelarc[7], who explores the body, technology, and cultural interface, delving into the post-human world of possibilities.

We present some interactive installations to highlight a certain perspective within interactive art in the 1990s: *The Legible City* (1989), by Jeffrey Shaw[8], is a partially physical interactive installation that involves the presence of a bicycle and the interactor. It is also partially imaginary with projected images of the cities of Manhattan and Amsterdam in the form of text in 3D animation. "The image responds in real-time to the direction and speed of the interactor" (Popper, 2007, p. 236), connected to electronic sensors on the pedals and handlebars of a stationary bicycle. *A-Volve* (1994), by Christa Sommerer and Laurent Mignonneau[9], is a water tank that houses artificial life forms, drawn on a computer screen, adapting and interacting within a virtual environment. These artificial organisms can have a long or short life depending on their interactions and the water pressure within this ecosystem. *Terrain_01* (1993), by Ulrike Gabriel[10], is an interactive solar robotic installation where two interactors sit facing each other, with robots between them that live on a glass plate. The interactors wear wearable interfaces on their heads, equipped with a brainwave detection system that determines the behaviour of the robots. In *Osmose* (1995), by Char Davies, there is movement through different mediums. "Whereas early virtual environments utilised portals that rendered transitions abrupt, in the image world of *Osmose* the observer experiences osmotic transitions from one sphere to the next, seeing one slowly fade before it amalgamates into the next" (Grau, 2007, p. 222). The spectator enters a state of immersion in the transformations of that digital landscape, experiencing sensations of lightness, lack of gravity, and multidirectional movements. In *Text Rain*[11] (1999), by Camille Utterback and Romy Achituv, the interactor uses their body to interact with falling letters in a projection where the interactors appear in black and white, creating surfaces with their bodies.

"In the installation, the classic artistic object closed in on itself is not important, but rather the dramatic confrontation of the environment with the spectator" (Plaza, 1990, p. 14). Technical interfaces

> [...] play a role similar to the "means" that humans need to communicate and facilitate the coupling of different systems. In this process, it is a matter of both seeking to reduce the distance and time of communication and achieving the optimization of reaction time and the flexibility of interrelation. (Giannetti, 2002, p. 118)

Chris Salter (2010) observes that "most interaction projects focus on images and sounds; however, there were also individuals who explored the translation of sensing-based data into other types of non-digital materials" (2010, p. 325). Derrick de Kerckhove tells us that "with interactive arts, we are beginning to move from a passive, one-way relationship with our screens to an interactive relationship" (Kerckhove, 1999, p. 64).

Artistic practices in interactive processes

Interactive art, as an action, is a blend of vision and movement. It involves a strong sense of thinking-feeling the qualities of movement, not just seeing bodies in motion. It engages in speculative, experimental work with technology; it technically speculates, creating a collective exploratory thought (Massumi, 2008). In this regard, interactive work presents itself as a collective creation produced through various technologies that associate individuals and mediums. One aspect of interactive art is its innovation in vision and multi-sensory

5 Ver «http://littlepig.org.uk/»
6 Ver «https://tonidove.com/»
7 Ver «http://stelarc.org/_.php»
8 Ver «https://www.jeffreyshawcompendium.com/»
9 Ver «https://www.interface.ufg.ac.at/christa-laurent/?fbclid=PAZXh0bgNhZW0CMTEAAabLs84jk8zeF1UnY6vf9I4CSx6Q6UfkMB8AkTGOb4L-ga9NtSF7U_fr22u0_aem_kaubnTOt8P0hiShitVNhow»
10 Ver «http://www.lllllllll.de/»
11 Ver «https://www.youtube.com/watch?v=f_u3sSffS78&ab_channel=MediaArtTube»

Image 1. Maurice Benayoun, *World Skin*, interactive installation, 1997.«https://en.m.wikipedia.org/wiki/File:WORLD_SKIN_%283%29.jpg»

perception, which leads to interactivity and the development of aesthetic communication techniques. This occurs not through the domination of one sense, but through a synesthetic experience where the visual becomes haptic.

This is not in the sense "of viewers activating the meanings of a text as they consume it, but separate elements of the installation converge on the body of the viewer, making them the locus at which some of the possible meanings are activated" (Wood, 2007, p. 144). The process of incorporating elements occurs within the artwork itself, as the technology remains open to interventions.

> These different digital interfaces inscribe the presence of technology in a very distinct way, giving us the opportunity to experience and reflect on how these technologies enable a range of space-time incorporations. (Wood, 2007, p. 161)

In interactive installations, the entire environment becomes the artwork, and the public's space forms part of the artwork itself, with the audience shaping the structure of the work. The viewer becomes an interactor in interactive processes. It is worth noting again that engagement with the artwork is not limited to a predefined action, such as pressing a button, but rather involves experimentation and bodily engagement.

In Maurice Benayoun's[12] artwork *World Skin* (1997), the visitor, while looking through liquid crystal glasses, is transported into a 3D war-ravaged landscape and interacts through a joystick and a camera.

> With a joystick, it is possible to navigate around soldiers from various countries and eras. They are there like ghosts in a kaleidoscopic pattern; static and lifeless images of war. The deeper we delve into the sphere of

12 Ver «https://benayoun.com/moben/»

> images, the more we recognize their infinitude (Grau, 2007, p. 277).

The artist places the visitor within the scene, provoking them to engage in the drama through a camera that emits machine gun sounds when triggered. Even without having participated in a real war, visitors become characters in this warlike theater of images, their bodies shaken by sensations. The digital image emerges as a provisional update, capable of shifting from linearity to strangeness (Image 1).

The group of artists and scientists, Palindrome Inter-Media Performance Group[13], founded by the German artist Robert Wechsler, has been developing creative processes based on the relationship between body and technology since 1995. They have performances in which dancers interact with sensors, and the contraction of muscles transmits signals to a computer, activating different sound channels. In this way, the body creates its own music through movement (Fredrich & Oliveira, 2023). Maíra Spanghero (2003, p. 46) mentions that Wechsler's group developed three software programs for their artistic proposals: *Touchlines*, which allows lines to be drawn on the captured image, triggering musical notes, text fragments, or changes in lighting; *Color Recognition*, which recognizes the color of each dancer's costume; and *Dynamic Fields*, which locates the quantity of movements in a specific field, enabling audience participation through the capture of their images. In *Heartbeat Duet*, "two dancers have electrodes on their chests and transmitters in their pockets to capture the heartbeat, which is then converted into a musical structure" (Spanghero, 2003, p. 45, our translation). This artwork explores the artist's actions, enabling their movements to produce audio (Fredrich & Oliveira, 2023).

Kwastek (2013) highlights important aspects for analyzing interactive aesthetics and mentions key characteristics that contribute to the discussion of the aesthetic potential of the artwork, such as the artist, the actors, the assistants, the recipients, the technical system, and the space (Fredrich & Oliveira, 2023). For Kwastek, "interaction systems not only enable actions; they also have their own processuality, which, although designed or programmed by the artist, acts independently of him" (Kwastek, 2013, p. 97).

The projects developed by the Canadian art and technology laboratory Topological Media Lab[14] emphasize that the body is not limited to its outline but expands through space and the environment in which it exists. It is important to consider what happens in the space between bodies and in the environment that supports them. The artwork *TGarden* (1997-2001) creates a responsive environment where interaction goes beyond the limits of the body; the relationships between bodies take place in an environment that undergoes changes. In their installations, they use interactive and responsive environments that focus on the question of how the human becomes human. They do not limit the human to anthropocentric issues but explore a perspective that is both social and computational, utilizing new forms of gestural media, expressive instruments, and computational systems that support their performances and installations. These responsive environments make explicit the active presence of the medium and stimulate analogical relationships between bodies and media.

Additionally, the Italian group Studio Azzurro[15] (Image 2) is noted for its production of interactive artworks. According to the artists, even though interactivity is part of human knowledge, digital technologies have fostered a different relationship between the audience and the artwork. The spectator is seen as a user responsible for producing the experience. The interactor assumes the role of perceiving a wide range of possible variations, acting more as a co-author than a passive observer. Playfulness becomes an intrinsic component in most interactive forms, as interactivity is relational; it occurs through the act of experiencing, perceiving, and inhabiting the artwork, thereby creating one's own narratives.

Another artist who introduces interactive digital technology into his artistic proposals is the Catalan Marcel·lí Antunez Roca[16]. For Roca, digital art has

13 Ver «http://pal.palindrome.de/about/»

14 Ver «http://topologicalmedialab.net/»

15 Ver «http://www.studioazzurro.com»

16 Ver «https://www.marceliantunez.com/biography/mini/»

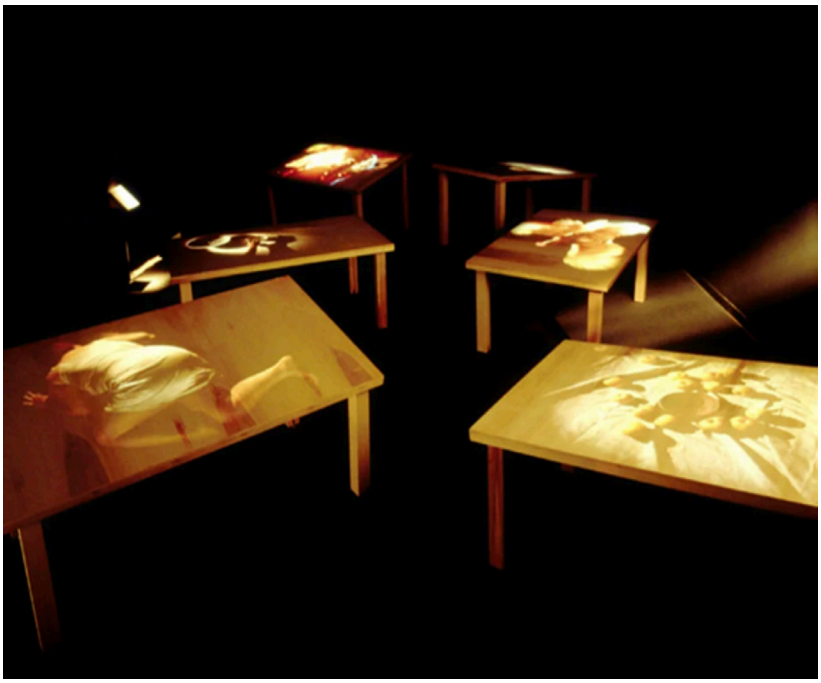

Image 2. Studio Azzurro, *TAVOLI (perchè queste mani mi toccano?)*, interactive installation,1995. «https://vimeo.com/34832992»

particularities, as it requires planning, the construction of prototypes, and the use of tools in a differentiated way. These differ from performances based on open texts and improvisation in actions and music. The elements are flesh, biology, organisms, and machines. In the works *El Robot JoAn* and *Transpermia* (2005), a mechanical nature is concealed behind a humanoid form. By not separating body and consciousness, Roca avoids the notion of a body that needs to be transcended, so that body and consciousness are mutually modified by culture and biology. He questions whether machines might represent a new stage in biological evolution. He constructs a unique interface in his installations and performances, producing a new category of performance, transgressing established conventions about the body and redefining the very roles of actor and spectator (eco-sistematurgy). He clarifies that his methodology consists of a Sistematurgy:

> My technological work gave rise to Sistematurgy. Sistematurgy reproduces and extends the technical field that originates around any computer: interface, CPU, and peripherals. Sistematurgy extends to other media, such as mechanics, robotics, or biology (Roca, 2006)

He applies this method primarily in his performances and installations as a tool for the composition and execution of interactive works. Sistematurgy is based on four points: interface, computation, means of representation, and user. Furthermore, his work shows a pronounced approach to biology. In this sense, many artists and theorists announce that a post-organic body originates in interactive art, one that is not based on representations but on actions that make the body interact.

In urban installations, Canadian artist Rafael Lozano-Hemmer[17] speaks of a *relational architecture*, aiming to expand non-institutional possibilities and the potential for encounters by constructing digital

17 Ver «https://www.lozano-hemmer.com/»

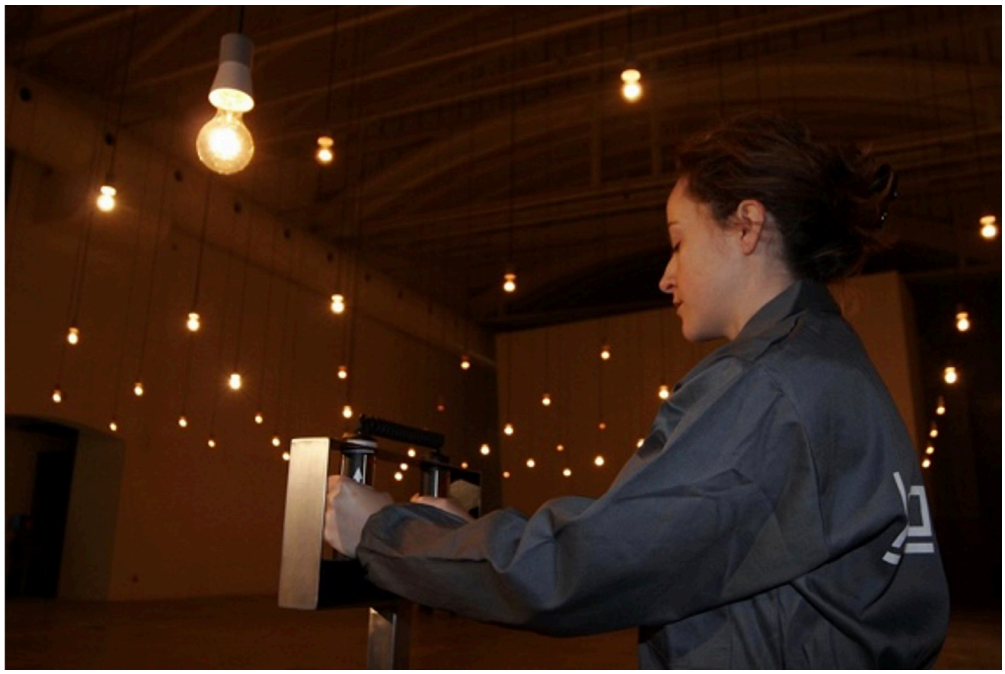

Image 3. Rafael Lozano-Hemmer, *Pulse Room*, interactive installation, 2006. «https://www.flickr.com/photos/nearnearfuture/2047394419»

installations where the body is provoked to experience itself and build the artwork. There is no autonomous subject independent of the landscapes. For example, in the work *Pulse Room* (2006), which makes explicit that landscapes are constituted by the intensities of bodies and that the artwork literally only exists with the presence of the viewer's body. It is the pulsations of the viewer's heartbeat that construct the architecture of the environment (Image 3).

One can generate conditions like pressing an object here and having a light turn on there; however, my body also mixes in such a way with this other body-object that it produces something new, resulting in the effect of relational architecture, where the relationships between bodies and media make spectators feel like they belong to that landscape. "The message is that the subject and technology are inseparable, share the same space, it is not about instructions but about fields of co-presence" (Lozano-Hemmer, 2007, p. 139).

In the work *Body Movies* (2001), photographs of people in an urban space blend with the shadows of viewers moving through that space in real time, merging into multiple affections in a public space that previously functioned more like a stage for ready-made narratives. The viewer uncovers the playfulness inherent in the mixture of bodies; through shadows, they allow themselves to touch other bodies and interact voluntarily. They create their own narratives with other bodies that attract them, shift from their usual postures, play, and invent new urban landscapes. As the artist himself puts it:

> What I want is to shake up those values and create something dysfunctional, a moment of resistance and of rejection of those preconceived mantras. I look for the "special defects" that allow me to activate the imperfections, the disruptions; "to disrupt" seems to be the most precise term for describing what I want to do. (Lozano-Hemmer, 2007, p. 141)

Image 4. SCIArts, *Meta Campo*, Instalação Interativa, 2018. «@ SCIArts»

Lozano-Hemmer seeks spatial expressiveness that is relational. The urban space is given the sensible signs of the animal environment—the capacity to affect and be affected—placing viewers on alert for what happens to them. By inserting another medium—the technological medium of projections—into the urban environment, he provokes the emergence of a new associated medium between media and bodies.

Lozano-Hemmer uses shadows in various ways to facilitate interaction. In *Under Scan*, shadows provide visibility to figures projected on the ground that are otherwise hidden. In Body Movies, shadows extend the bodies and enable them to touch each other. The shadows of spectators awaken both themselves and others in the public space, anticipating interaction. The surprise generates new information in the relationship between the artwork, humans, and the environment. The presence of my body brings forth another body in an urban space that claimed to be neutral. There is a paradox of life and death in the artwork: my living body is awakened by a body that should occupy a resting place.

The Brazilian group SCIArts[18] aims to express, in its production, the complexity of the relationship between these elements and the representation of contemporary artistic and scientific concepts that demand new media and poetic possibilities. The work *MetaCampo* (2010) operates with the invisible forces of nature. *MetaCampo* (Image 4) is an interactive installation that involves sensors, a digital control system with a computer and microcontroller, and electromagnetic actuators. The interaction occurs through the action of wind, external to the exhibition space, and the presence of people within the work's internal space, operating with the concept of autonomy. Vertical rods are moved by the artificially induced wind. The idea of "system as a work of art" is part of a procedural and relational view of the world that is increasingly asserting itself in all fields of knowledge. The system work-human-environment is inserted into

18 Ver «https://www.sciarts.org.br/»

other macro and micro systems, interconnecting different space-time relationships (Hildebrand, et al. 2009). The relationship between nature and technology, through the use of solar energy, builds the poetry of the work.

Salter (2010) emphasises that there are numerous modes of interactivity with digital technologies in which the roles of artist and spectator are altered. He highlights the indispensable relationship between environment and event, between environment and everything that happens in the experience. Therefore, in the artwork experience, the spectator is included as part of the event.

Therefore, interactive artworks, i.e. techno-aesthetic objects, can propose new relationships that involve new interactors and means in other processes of subjectivation. Art proposes different experiences and other ways of living. Art is an aesthetic construction of the world, making visible what does not yet have visibility and assigning meaning to newly invented compositions. Through art, one can slow down daily life, producing other dimensions of time and perception, and inhabiting new environments. Thus, art constitutes itself as a profound thought that enhances life through aesthetics.

Considerations beyond interactive art

Finally, we question whether we can still speak of interactive art today, amid emerging technologies such as machine learning, generative artificial intelligence, organoid intelligence with biocomputers using brain cells, biometrics, and other types of intelligence of the future driven by technological acceleration. Given that such technologies imply constant interactions between humans and machines, changes in human language, cognition, embodiment, and aesthetics, interactions permeated by information networks, how long will it be possible to maintain a focus on artistic practices that address specific issues of interactivity, given a scenario that imposes recursive interactive technological mediations?

Seeing that art and technology have always been embedded in a context that links technology to culture —from their inception with cybernetics, to connecting contemporary art with science and technology— we point out the effectiveness of their productions in understanding emerging algorithmic technologies. Productions in tune with approaches that indicate alternatives beyond dichotomous and polarised stances between human and machine, stances that prioritise a model of domination, either of the human or the machine, or adhering to a purist model that dissociates technology, culture, and nature in favor of universalist and hegemonic ideas about what we accept as human and machine. Such productions and approaches are situated in a post-digital and post-human moment, demanding systemic and processual views in the construction of worlds.

By proposing to consider technologies and their operations through various theorists, we aim to problematize the possibilities of reflecting on the mutual relationships between humans and machines. As was mentioned, machines can only take the place of humans when they reflexively centralize the function of a "tool bearer," a human who only performs tasks or replicates known patterns (Simondon, 2017). Technology can only be incorporated into culture if the relationship between humans and machines does not establish patterns of inferiority or superiority but, on the contrary, fosters relationships of respect and reciprocity, embedded in a technical culture.

Inspired by Simondonian notions, we aim to deconstruct both negationist and salvationist perspectives toward technology, emphasising the importance of understanding the modes of operation and interaction of techno-aesthetic objects within culture. This exploration leads us to consider the potential technological indeterminacies and determinacies, particularly with the rise of generative artificial intelligence (Gen-AI) systems.

Examples include the popular ChatGPT and DALL-E platforms developed by OpenAI[19]. These platforms are integrated into various applications and services, enhancing their capabilities in advanced

19 Ver «https://openai.com/chatgpt/»

natural language processing and image generation from textual descriptions. Alongside other AI platforms, we observe AI's capacity to create code (e.g., GitHub Copilot, Replit Ghostwriter, Tabnine), generate texts (e.g., ChatGPT, Writesonic, Jasper), produce audio (e.g., Resemble AI, Murf AI, Sonantic), generate images (e.g., MidJourney, Stable Diffusion, Runway ML), and create audiovisual content (e.g., Runway ML, Synthesia, Pictory). Furthermore, we see an increasing integration of technologies, such as the fusion of virtual assistants such as Amazon's Alexa[20] combining with conversational AI like ChatGPT to engage in dialogues, whether oral or textual. These collaborations enable responses that range from everyday queries to more complex technological, scientific, and artistic propositions, demonstrating the rapidly evolving and interconnected landscape of AI-driven platforms beyond the more pedestrian tasks of controlling smart home devices, playing music, setting alarms, providing weather and news updates, etc.

Even though we are still in the early stages of using virtual and augmented reality platforms and systems that utilize AI, the subject is already becoming highly complex. We anticipate significant technological and cognitive leaps that will require us to reconsider the type of human-machine interaction we are currently experiencing, in order to better understand the human transformation that lies ahead. It is essential to remain vigilant about the cognitive and affective changes that these technologies are provoking, both on individual and societal levels. Moreover, we should critically examine the potential of human engagement with algorithmic technologies, whether it allows us to explore the indeterminacies of machines and human unpredictability or, conversely, whether it imposes restrictions on such engagements, limiting our ethical and aesthetic choices and determining our behaviours in a predictable and calculated manner, ultimately serving specific economic and political interests.

Since the 1950s, there have been studies on artificial intelligence. However, with the development of machine learning and the acceleration of computational innovations, we now observe not only pattern recognition but also the possibility of creating new content with AI. We emphasise that this occurs "with" AI, meaning humans are actively involved in such productions; AI does not operate independently. The generated data arises from human-machine interaction, which includes the creation of datasets, data preparation for training, algorithm training, model testing, the use of the trained algorithm, and the generation of data from the algorithm. In other words, between the inputs and outputs of machines, data and patterns are mediated in some way by humans.

Working "with" AI has been generating perceptual, cognitive, and affective changes. Symbolic productions and the attribution of meanings occur through the interaction with algorithmic technologies, not in isolation and not solely generated by machines. As mentioned above, there is a continuous interplay between human and machine. Given these implications, we recognise the need for an understanding of interactions at biological, technological, and aesthetic levels—essentially, a consideration of biotechnological interaction in art.

At present, when contemplating biotechnological interactions, it is unfeasible to separate artistic and technological productions from their social, economic, and political contexts. We must also reflect on the role of the arts in raising critical questions about the social and economic issues implicit in each technological innovation.

> With the purpose of exploring and problematising AI, art invites us to review its own aesthetic parameters. Techno-aesthetic objects are an extension of the natural and cultural world, which as a point of convergence and their positioning will be through an aesthetic gesture. Aesthetics makes it possible to go beyond primary technological procedures, just as technology is the means by which a certain aesthetic is produced. (Oliveira, 2023, p. 219)

That said, critical understanding alone is not enough; we must also be proactive in the arts, finding creative strategies to open up the world. As Jean-Luc Nancy states: "Art is always there to open the world, to open the world to itself, its possibility

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of the world, its possibility then to open meaning, while the meaning already given is closed" (Nancy, 2014, p. 25). This involves opening the senses, opening ourselves to the plurality of the outside world, which reflects the plurality of perceptions in interactive artistic practices.

Thus, with the aim of reexamining and even dissolving our boundaries, theorists and artists are contemplating the worlds we are constructing with emerging technologies. They are questioning the kind of society we want to live in and the directions we are steering these technologies in our daily lives. Despite significant challenges, such emerging technologies can, instead of merely limiting and determining, provoke us to expand our awareness of the psychosocial patterns we fabricate and share, opening us up to new forms of interaction in art, science, and technology.

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