# Becoming-there: Natural Presence in an Art of Artificial Ecologies

(Invited Paper)

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***Abstract*—We discuss an evolving series of interactive artworks with respect to theoretical perspectives regarding the concept of presence.**

## I. Introduction

> The machine does not isolate man from the great problems of nature, but plunges him more deeply into them.
> — Antoine de Saint-Exupéry, Wind, Sand and Stars

Since 2007 the authors have been creating a series of "artificial nature" art installations, in which human visitors become actively embedded within virtual ecosystems. In part we are motivated to explore the full open-ended potential of computation as a creative environmental medium. More fundamentally we are motivated to provoke extended experiences which recapitulate something akin to child-like wonder regarding the complexity, beauty and sublimity of nature: an engaged nature-like aesthetic experience. The success of our works depends on the qualities of this experience: to what extents visitors become absorbed within the generated world, and find meaning in the actions they perform, the responses they find, and the open-endedness evoked. Although our practice has evolved partly independently, these qualities can be understood from a human-computer interaction (HCI) perspective utilizing the concept of presence.

Presence is generally understood in terms of a subjective sense of "being there", or being engaged such that the artificiality of the situation becomes suppressed. It has drawn variously upon aspects of subjective, immersive, cognitive, embodied, social, and situated experience, and has been is widely applied to virtual reality (VR) and augmented reality (AR) systems. Applying the concept of presence to interactive open-ended artworks seems inevitable, however we find that doing so effectively requires additional sensitivity. We hope that the intersections and divergences found may also contribute insight to both HCI and interactive art communities.

Interactive, technological art is deeply concerned with machine-mediated human experience. What a work means depends essentially upon what we can do within it, what we can experience through its responses, and how it reflects critically upon ourselves and our environment. Often however what we can do is purposefully left open-ended, with artists "driven by the wish to create a complex interactive artwork that can constantly change, adapt and evolve as users interact with the system…" [1]. Many artists are attracted to the medium for the sublime potential of creating worlds that endlessly evolve through intimate interactions between human and machine [2], presenting new responsive worlds as "strange ontologies" [3] in continual processes of becoming.

Such open-ended (free play, non-narrative) interactive artworks have been shown to motivate participation and engagement [4], making them attractive for HCI research. However the task-centric, goal-oriented focus on system design and user expectation that HCI studies typically manifest is not ideal: an open-ended interactive artwork is not created to satisfy specific user goals or requirements. Visitors enter and leave an artwork volutarily and sporadically, and in most cases do not require or expect a user guide [5]. Moreover, art in general is conceptually multi-layered, thus HCI analyses must take special care to account for the critical-theoretical context in which an artwork stands [4].

## II. Presence

The concept of presence is central to understanding the experience of mediated and virtual reality content. However as a terminology it remains problematic, with multiple definitions [6] [7] [8]. Schuemie et al. provide a useful review in [9].

It is widely agreed that presence can be strengthened by immersive mediation. VR technology contributes to immersion through high frame-rates, low latency tracking and interaction, good stereopsis, and depth cues. High definition spatialized surround sound, correlated with the image, is also highly significant; as are other multisensory correlations such as tactile interaction [10]. Steuer however is critical of relying on immersion alone to understand VR as a technology [11]. He suggests instead using the concept of presence to understand VR as a particular kind of experience. Immersion is an objective measurable property according to the degree of sensory completion, while presence forms part of the human response to the system [10]. Immersion is maximized by suppressing and replacing sensation of the real, such as in the cinema and CAVE-like VR environments; while presence can be strongly felt without complete suppression of the real, such as the superpositions of headphone music or AR applications.

Lombard and Ditton [12] refine the concept of presence in terms of "the perceptual illusion of non-mediation", describing six aspects of presence: social richness (intimacy, immediacy), realism (perceptual, social), transportation (you are there, it is here, we are together), immersion (the suppression of the real, psychological absorption), as an actor within the medium (virtual characters), and finally as kind of global, anthropomorphic projection (experiencing the medium as an actor in itself). They also emphasize the continuous requirement to maintain this illusion, and the involvement of sensory, cognitive and affective processing. In all aspects the emphasis is on providing users with the illusion that the experience is not mediated, with humans behaving as if the mediation was not there. This can be achieved by making the mediation invisible, or by transforming it into a social entity. However the definition becomes problematic in terms of what is or is not "mediated": where do we draw the line between natural and artificial mediation?

Many researchers have found that presence depends crucially upon how successful actions are supported, since the reality of daily experience depends on functionality more than on appearance [6]. "Being there" is being "able to do" or being "able to act upon", echoing the affordance theory of J. J. Gibson. Herrera et al., found that presence is more strongly correlated with a sense of experiencing "agency" (the satisfying power to take meaningful action and see the results of our decisions and choices) than with the illusion of "being-there" [13]. The sense of agency is strongly related to the sensation of interior and exterior of the body. (Interestingly, the term "presence" itself derived from Marvin Minksy's suggestion of "telepresence": that a physical teleoperator user might develop a sense of being in a different place, with the body of the machine becoming the body of a human [14].) For example, Gonzalez-Franco et al. suggest that voluntary (interior) actions should be perceived as emanating from within the body, thus non-observational and predictable; while on the other hand, phenomena that are observed outside the body and unpredictable are understood as part of the exterior world [15].

## III. Time of Doubles: an Artificial Nature

The authors have developed a series of several "artificial nature" artworks since 2007, drawing upon artificial life and complexity to present engaging virtual ecosystems as interactive installations. These installations have been exhibited at numerous international events [16]. Our goal has been to construct nature-like aesthetic experiences using the mechanisms and evolutionary processes of life. To better achieve this motivation, we integrated intuitive, multimodal interaction with a computational simulation of a complex ecosystem, displayed within environments of high sensory immersion including large-scale display, wide field-of-view, stereographics, high frame-rates, and 3D spatial audio. We have also explored multi-modal input including touch surfaces, ambient microphones, infra-red and depth camera sensors, with an emphasis toward low latency and natural "transparent UI".

The early artificial nature installations utilized CAVE-like VR configurations to present infinitely navigable worlds, which conveyed a powerful sense of "being there" (or "it is here"). However the fully immersive navigable worlds led to essentially single-user, egocentric interaction with a disembodied role of observation. The most recently exhibited installation "Time of Doubles" instead attempts to create a fusion of physical and virtual spaces [17]. 3D projection is still present, however the screens are now architectural objects within the gallery space, rather than invisible walls (see Figure 1). Through careful alignment of virtual projection these screens appear similar to mirrors or windows into another world, akin to Alice's Looking Glass.

Engendering the sensation of presence is of critical importance to the work. During development we found (in agreement with the literature) that low-latency, high-bandwidth interaction is absolutely essential, while photo-realism is not important at all. Stereographic projection makes a significant difference, at the cost of being encumbered with glasses. Other depth-cues were helpful (particularly shadows). Finding an optimal virtual projection (and stereo parallax) for the average visitor position and height was very helpful. Surround sound and spatial ambience significantly increased the sense of "being there". However we suspect that the most important contributor to presence is the interaction with the animate content.

The central theme of interaction in our work is that the human visitor becomes an integral part of an evolving ecosystem. However visitors are neither pure observers nor god-like manipulators: interaction is both voluntary and involuntary, and consequences are easy to perceive yet difficult to predict. Action in space, and even mere occupation of space, can affect the ecosystem through the introduction of kinetic forces and chemical or biological material.

The virtual world displays some familiar characteristics as our own, but is populated by unfamiliar life forms singing and swimming through the sensitive motions of dark fluids. Within this world visitors can also see their own and each others' double-images. Data from IR depth cameras in the gallery space are used to project visitors into the virtual world. The projected volume in 3D space is not an avatar, but a source of matter (imposing a much greater probability of particle emission) and energy (the kinetic flow between frames adds currents to a dynamic fluid simulation). The visitors' doubles are thus perceived as energy fields emanating nutrient particles which are eaten by the virtual organisms. Each organism must maintain an energy balance to stay alive, by finding and consuming particles in the environment. Visitors thus hear, see, and feel how they are fed to unknown lifeforms in this virtual ecosystem.

Time of Doubles builds upon the fact that we can very easily psychologically project ourselves onto double-images despite the third-person perspective, just as we do with mirrors and avatars. Visitor identification with the double is quite rapid and remains persistent; despite their non-human and non-biological appearance. We can understand this in terms of the low latency and high bandwidth of data (the sense of body-ownership with a synchronously correlated double is known to be strong [15]), as well as the fact that a mirror "serves the execution of a task which without the mirror would become much harder" [18].

However, as noted in the introduction, the challenge of interactive art is that it is largely taskless: users do not enter with a specific goal to achieve. Nevertheless, through the modes of interaction and agency an artwork supports, visitors may begin

Fig. 1. Time of Doubles exhibited at the Seoul Olympic Museum of Art, Seoul, Korea, 2011. Visitors on each side of the screen can interact with one another through the virtual ecosystem.

to take on roles. A wide variety of actions and nuances are possible in the Time of Doubles virtual world, using the real physical body, leading to engagement through agency. Visitors standing still can observe their doubles intensify into a flaming figure; watch the populations of artificial organisms approach and then consume them; notice how the population growth rate explodes and hear the isolated chirps they make become a dense cloud of sound; move away and see the currents and eddies diffuse through the 3D space; watch and hear as the populations become separated and evolve into distinct genetic branches. In Time of Doubles there is no manual; visitors must learn by discovery just as in nature. Some visitors discovered how to guide swarms of organisms through the space by leaving particle trails; to create vortices by spinning and kick up nutrients from the floor with their feet; to conduct the evolving sound-scapes of organism stridulation; to accumulate particles into high densities and then propel them through the fluid; to create bridges of living populations between each other; and so on. All such actions reinforce the perception of interiority and exteriority through bodily action in the virtual world, despite the non-human roles they play.

The multi-user and multi-perspective ("locally telematic") aspects of Time of Doubles could contribute a social character of "being together", even though identifying the doubles of others is sometimes difficult. Nevertheless we have observed that most visitors concentrate on interacting with the fluid medium and organisms, rather than with each other.[1] We would like to suggest therefore that interaction with other life-forms leads to a kind of presence which is not quite social, but certainly more than machinic; perhaps it could be called an "ethological" presence?

Lombard and Ditton suggested that presence can be achieved by making mediation invisible (such as in CAVEs) or by transforming the whole medium into a social entity [12]. Visitors clearly feel strong presence while interacting with Time of Doubles, however it is problematic to understand in Lombard and Ditton's terms. For example, no attempt is made to make the large-scale architectural screens invisible. In our personal experiences the warped projections appear as if the screens simply extend the physical space into a new dimension. It is not quite clear whether this constitutes a "you are there" or an "it is here" form of transportation presence, nor whether it should be considered as mediated or non-mediated; perhaps humans are ready to accept the superposition of both? An alternate reading could be that our interactions with virtual organisms of the ecology transform the whole situation to a social level. Lombard and Ditton do suggest that we perceive virtual pets as social actors, but extending this to an entire ecological world is perhaps too large a leap.

Throughout the series we have followed a design principle of integration and consistency: all visible (and audible) elements are active, and each one can interact with every other (including the human visitors). Furthermore, although the worlds are sensitive to humans, they continue to change by its own laws when visitors are absent. Without visitors, the world-fluid is filled with life seeds that barely grow, but with humans present the populations can explode into alien orchestras. These principles were chosen in order to deepen the sense of being present in a world supporting open-ended exploration; through agency they also strengthen the sense of interiority and exteriority. For us, it is important that visitors

[1]One possible hypothesis for this preference follows from the fact that interaction with alien life-forms is a relatively rare opportunity, engaging visitors through curiosity.

should not experience the work as complicated, despite the underlying complexity of the systems. The complexity is required only to convey open-endedness through interaction, such that each spectator can have their own insights integrating play, observation, and aesthetic experience.

## IV. Continuation

German art historian Oliver Grau described immersive art in terms of a mental transition distinguished by a "diminishing critical distance to what is shown and increasing emotional involvement in what is happening" [19]. Bilda et al. suggested understanding interactive art experience from a perspective of situated, embodied cognition [20], in which mental processes must be understood in terms of bodily interactions with the world, mental processes, and the perception of environmental feedback: "thinking through doing". Such perspectives from the interactive art community can clearly draw upon the concept of presence; however as noted in the introduction, understanding interactive art also requires taking into account the multi-layered, non-task oriented character, as well as the critical context in which it operates.

Regarding our own work we have often it productive to refer to the metaphor of finite and infinite games [21]. Finite games have a specific goal: to become the winner at the exclusion of other players. They use inviolate rules in order to ensure the game remains finite. On the other hand, the only goals of an infinite game are to continue play and bring in more players. Rules exist only to ensure the game does not end (if the game approaches an end, it has failed, and the rules must be changed to continue play).

This distinction helps capture the generativity of the virtual world, the open-endedness of interaction, and of the meaningful experiences we hope it leads to; but it also incorporates the "being together" invitation of multi-user interaction and the engagement with alternate life-forms. We find it interesting to note that a sense of persistent continuity and inclusivity is a central condition of ubiquitous computing [8], and by extension, ubiquitous virtual reality (UVR) research [22]. The cultural context in which interactive art is made today is one which is increasingly immersed in computation. We hope to continue developing artificial natures in such a way that they can continue to grant transformative experiences, changing both the perception of the natural world and the conception of what "'artificial" means.

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