Interfacing the Real and the Virtual: User Embodiment in Immersive Dynamic Virtual Spaces

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Abstract: This paper discusses the performative boundary between the real and the virtual as it constitutes itself based on the potentials, conditions and abilities of Virtual Reality (VR), considered as both a technology and a medium. Starting from the prospects and the areas of application of 'new' technologies within the context of architecture, the paper seeks the point of intersection between an architectural perspective, a posthuman view and a technological potential. The focus thereby lies in the greatest challenge of VR, that is, the integration of the users as they interface the virtual and the real. The conditions and implications of such dynamic processes, perceived as space generating, rather than representing, are explored based on the authors' virtual environment: Uzume.

1 INTRODUCTION

The paper explores the conditions and capabilities of immersive, interactive technologies with respect to the production of dynamic, physically experienceable virtual (data) spaces. The authors will argue that this potential not only allows for a participant to physically inhabit a virtual space, as it represents a design, but rather constitutes the emerging ground for a space, which primarily unfolds in an experiential process. The premises and conditions of such a production of space are explored based on three different and yet interdependent aspects: its generative processes, the superposition of real and virtual places, and the issue of presence and embodiment. Starting from some of the perspectives of digital architecture in Section 2, the following sections discuss the specificities of the production as well as the inhabitation of emergent and responsive (virtual) spatial scenarios, based on the CAVE® environment *Uzume*.

2 ARCHITECTURE AND THE TECHNOLOGICAL INTERFACE

Architectural approaches in the early nineties, such as Marcos Novak's 'Liquid Architecture,' already explored computer generated spaces, seeking the 'gradual substitution of liquid patterns of change for structures of stillness' (Novak 1997). Driven by keywords, such as behaviours and emergence, these liquid-like reactive tectonics exist only in the digital domain and evolve in a permanent state of becoming, rather than aiming for a final form. Yet, there's more to such unfixed forms of architecture than their programmability, transaction and playfulness (Oosterhuis 2003). They also represent a continuous constitution of boundaries, a shifting, interfacing and perforating of these boundaries and a likewise unfixed multi-inhabitation of an emergent in-between. It is here, where Posthuman views on bodies and territories and immersive interface technologies meet architecture: as the unsettled ground is negotiated in an embodied process, the interface between the real and the virtual is fundamentally spatial. Virtual Reality systems offer a technological interface that allows for an apparent corporeal inhabitation, an interactive process and an experiential sharing of space as it is about to emerge. In a more conventional approach, the three-dimensional, multi-modal interface has proven to be useful for sharing data, such as a prototype, between various disciplines or different levels of expertise. A recent example would be the international architecture competition 'A Music House in Aalborg,' won by Coop Himmelb(l)au, in 2003. The entry requirements included the submission of immersive 3D visualisations, based on which the committee of judges made their decision.

2.1 Boundary Objects

In a talk at the KCDC, University of Sydney, the computer scientist Gerhard Fischer spoke of 'boundary objects' to support interaction and mutual understanding between different disciplines. He mentioned architectural (paper) models to serve as such boundary objects. While the term 'boundary object' seems helpful to specify what is particular about the capabilities of such aforementioned visualisations, it also identifies the characteristic of a virtual space, such as it is introduced in the following sections. The boundary object becomes physically accessible and sharable in the immersive visualisation of a proposal. An emergent, process-oriented, interactive production of space, however, is about loosing its 'objectness' and perpetually reconstitutes the boundary and thus its fluid extensions.

2.2 A Medium rather than a Tool

Producing a dynamically unfolding reality enfolds an ongoing mutual translation process, involving the conception of ideas, their representation, the exploration of the participant's role, as well as the comprehension of the shaping ability of all their interrelations.

Christiane Paul emphasises the major distinction between the use of digital technologies as a tool in the creation process and the employment of these technologies as a medium. Paul argues that only the latter offers a potential to exhibit generative processes in real time (Paul 2003).

The virtual environment Uzume, to be introduced in the following sections, addresses the significance of the medium and the interrelations between the generative, decisive representative and the unfinished, continuously becoming nature of such virtual realities.

3 UZUME: A PERFORMATIVE EVENT

Uzume [Japanese: whirling] is named after a Japanese Shinto goddess, whose myth tells of her strange dance with which she lured the sun goddess Amaterasu out of a cave, where she had hidden herself. Even though the virtual environment does not thematically refer to this mythological narrative, it likewise presents its visitors with a strangely playful, whirling behaviour. Immersed in Uzume, an abstract, dynamic and sensitively responsive environment surrounds the visitor, unfolding the communicative nature of an untameable virtual entity (Figure 1).

To communicate with this entity is similar to pursuing a dialogue without knowing the language of the other as the tension between responsive and yet unpredictable behaviours perpetually interferes with the illusion of control.

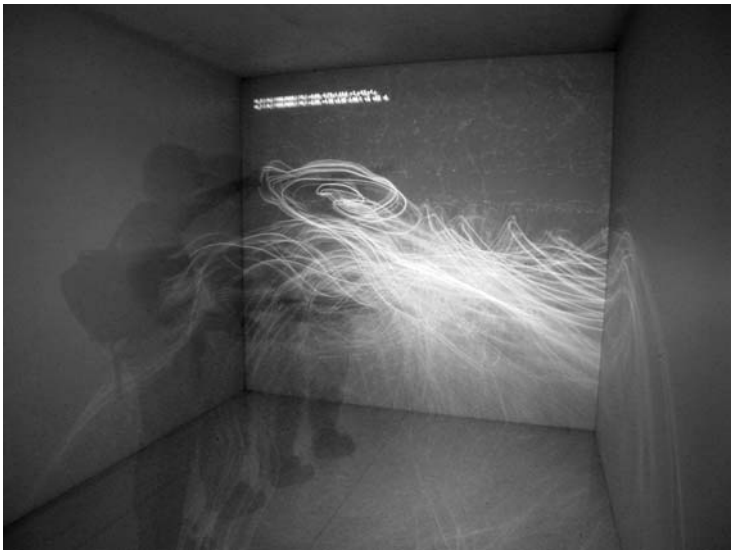

Figure 1 Uzume

3.1 Real and Virtual Space Intertwined

Implemented for a one to six wall CAVE® projection system, the participant's body becomes instrumental in exploring and experiencing Uzume's evolution. The environment's continuous becoming draws on Henri Bergson's notion of motion that precedes space (Bergson 1991). It is then not the participants' body but rather space that becomes a prosthesis, a fluid extension of their movements (Figure 2).

With respect to this discussion, the technological interface of current Virtual Reality systems, such as the CAVE, is regarded only a short-lived tool that allows and provokes the exploration of the specificities of such extensions. An interesting aspect of this spatial prosthesis is that it not only sensorially extends our body but that the human-scale, three-dimensional imagery suffuses our entire body. The interface allows thus for a simultaneous inhabitation of both, the physical space of the participant's body and the virtual data space, sculpted through the body's movements. One could argue that the immersive, embodying qualities of the CAVE® actually challenge the Cartesian split between mind and body–as moving and gesturing in this space, the expressed and the expression become inseparable.

Figure 2 Uzume continuously responds to the sensors' input

3.2 Rules and Instructions as the Building Blocks

The first design experiments with this medium addressed the idea of a dynamic, spatial structure, whose shape and evolution are exclusively driven by a continuous change of conditions. Without a pre-designed form, the spatial evolution emerges from the execution and representational mapping of rules and instructions. In the

course of the development, the focus of Uzume's realisation progressively shifted towards an evolutionary process that unfolds in the mutual interplay between the participant and the virtual opposite.

The illusion of Uzume relies on its apparently communicative abilities and, hence, on the interrelations of input and response, rather than its representational features. One of the most essential conceptual aspects of the interplay's design is an underlying set of rules and instructions, based on which Uzume responds dynamically and iteratively.

3.2.1 The Opacity of the Interface

The approach to emphasise the ambiguity of interactive and yet decisive control systems, stands in contrast to the intention of most present technological advancements. Their aim is to render the system's control mechanism and its interface as invisible as possible. Likewise, the presence of the application's code becomes more and more obscure and hidden behind the façade of the interface. Erkki Huhtamo sees the interfacing of 'humans and computers in a "user-friendly" fashion' as 'one of the guidelines of the digital culture since the late 60s' (Huhtamo 2003).

In order to offer the users, in Huhtamo's words, 'a glimpse behind the scene, to the engine room,' he speaks of a 'tearing down' of 'the veil of "user-friendliness", seen as a deception' (Huhtamo 2003). Even though Uzume responds to every movement of the participant, its 'unruly' behaviour rather aims to unveil the ambiguous nature of computer controlled systems and in particular the illusion of control.

3.2.2 The Transition from the Object to a Process

The virtual environment investigates the potential to experience space and its flowing transitions as a dynamic, unforeseeable spatio-temporal event. Opposed to a stochastic process, the space's transitory quality emerge from the nonlinear behaviour of chaotic systems in relation to the behaviour of a participant, whose gaze and movements are constantly fed into the system.

Roy Ascott has argued that we currently experience a transition from 'content, object, perspective, and representation' to 'context, process, immersion, and negotiation.' (Ascott 2002). In a similar fashion, Christiane Paul links the transformation of the representation's status to the quality of emergence and hence to the data's dynamic context. The 'transformation of the status of representation itself', according to Paul, 'becomes a process that constitutes a convergence of language and mathematics, which in turn has the potential to drive a multi-sensory "display".' Here the issue of context becomes particularly important, as 'for any given set of data, there are multiple possibilities for giving it a visual form, which in turn lend themselves to reconfiguration. This again leads to contextual shifts: the context provided for creating meaning of a given set of data is to a large extent determined by the dynamics of the interface.' (Paul 2003).

3.3 Uzume's Building Blocks: Four Interrelated Compositional Layers

Uzume's chaotic nature as well as its permeable interface is deeply intertwined with its soft- and hardware building blocks. The sensitivity of the environment is based on the chaotic behaviour of nonlinear systems, embedded in a force field and a vibrant composition of sound objects that combined unfold an abstract, dynamic evolution of emerging spatial pattern.

3.3.1 Strange Attractors

Uzume's 'whirling' appearance is based on spatial representations of the temporal behaviour of nonlinear, chaotic systems, so called Strange Attractors (Figure 3). Their parametric fields are spatially mapped around the user's body, and hence, by physically moving around inside the projection space and gesturing with their arms, the participants actually traverse the various chaotic states of the system.

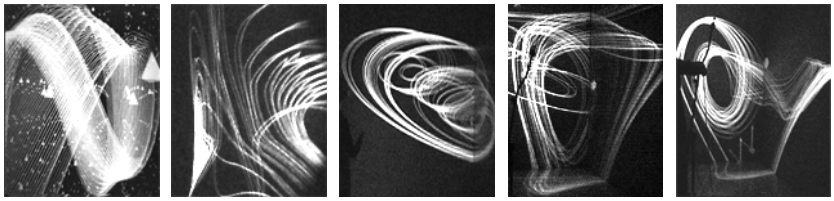

Figure 3 Uzume's various strange attractor types

3.3.2 Force Field

At the same time the participants' physical exploration subtly transforms a viscous fluid-like force field, whose force interplay continuously affects the shape of the attractors' trajectories. It sensitively reacts to the physical presence of the visitor by locally displacing and transforming the chaotic, whirling patterns and adds an almost tangible quality to the projected virtual world.

3.3.3 Multi-channel Sound Space

The real-time sound space consists of various discrete voices, whose compositional parameters are spatially mapped around the user. As the visitor touches the floating sound objects, different combinations of these voices develop endless variations of individually modulated, tenuous passages along the traces of the movements.

3.3.4 Additional Control Layer

An additional control layer governs changes in the spatial configuration, such as transitions between various attractor types, and their individual initial parametric settings. It is indirectly influenced by the participants in that it continuously tracks their spatial proximity to various attractors.

3.4 Inhabiting the Space: The Interplay between the Participant and the Virtual Opposite

By deploying a nonlinear, dynamic system to reinterpret and represent the participants' incoming data, it also becomes impossible for its authors to compose or to control the actual product. Similar to the experience of the participants, they are confronted with a non-reproducibility and a complexity, whose openness also relies on the fact that its potential evolution exceeds one's imagination. It is exactly this open, process-oriented design, however, that allows the participant to experience the environment beyond the authors' predefined interrelations.

As the participants are given neither instructions nor scores to reach, becoming acquainted with Uzume's otherness is supposed to be intuitive and playful. The dialogue unfolds in an interplay of provocations, allures and discoveries, in which the interrelationships between one's own gestures and movements and the environment's responses and modifications drives the evolution (Figure 4).

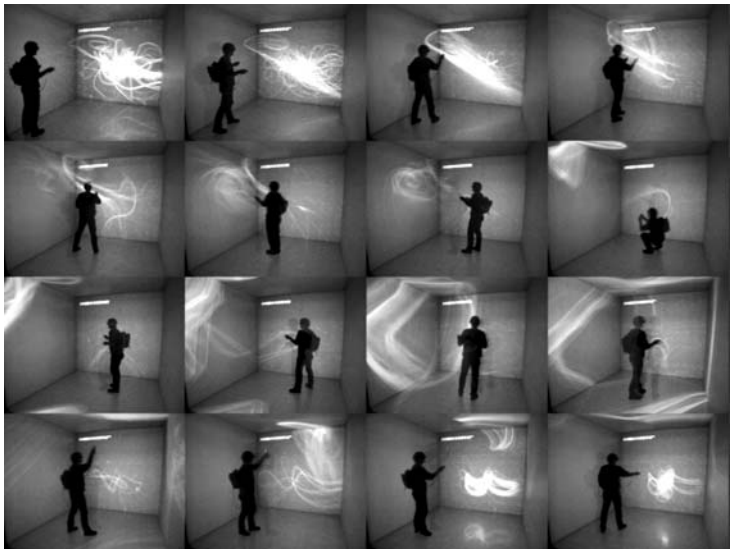

Figure 4 One-minute sequence of Uzume's evolution

Inhabiting virtual spaces already challenges the participant on a quite basic level; as s/he needs to negotiate between the isotropic conditions of the computer generated

and the experiential framework of the human, bound to horizontal and vertical. While many CAVE® environments present a world, which exceeds the (physical) projection space and are conventionally navigated through by the means of a joystick, Uzume's world is bound to the (physical) boundaries of its projection space that can only be explored and bodily 'occupied' by the participant's physical movements (Gemeinboeck 2004).

Hence the visitor's body becomes instrumental in communicating with the virtual opposite that despite its abstract appearance clearly reflects their engagement: Fast, large movements trigger fast changes that quickly propagate through the CAVE®'s space. Slow, small movements enable the participants to discover changes that occur at a reduced speed and within a local range.

4 CONCLUSION

The representation modalities of digital media enable a dynamic, fluid sculpting of our externalized thoughts through instantaneous modifications. Virtual Reality technologies, in particular, allow for a bodily inhabitation of these elastic data spaces. The future design of immersive interfaces can be expected to involve diverse fields, such as pervasive and wearable computing, mixed reality, and biotechnology. As the boundary object becomes connected, perforated, implanted and gradually dissolves as such, it is the user's body itself that becomes a multilayered interface, intertwining the virtual and the real.

VR technologies can be considered space-creating media, rather than space-representing. The key to this creation lies in the involvement of the user's body and the significance of its role in the emergent production and performative experience of space. Experience, body and space are inseparably coupled, as at least from an experiential viewpoint there is no such thing as disembodied space. As Lars Spybroek points out, 'one can really only talk about "space" as a result of an experiential body timing its actions.' (Spybroek 1998) Considering space in relation to experience as a dynamically evolving passage, also constitutes the framework of embodiment that, according to Katherine Hayles, 'always is contextual, enmeshed within the specifics of place, time, physiology and culture, which together compose enactment.' (Hayles 1999).

As such a dynamic production seems to open a space less familiar and secure, Lebbeus Woods has finely articulated its prospect: 'In freespace, what is lost is the familiarity of architectural and social norms, the reassurance of control by stable authority, and of predictability, certainty, and the routinisation of behaviour. What is gained is not an answer to the perpetual question of space, but simply a clear articulation of its potential. From this everything else flows.' (Woods 1996) If we can only imagine this 'freespace' to exist in the digital domain, it is our embodied cognitive capabilities that bind, connect and interface the experiences of the solid, stable real with those of the fluid, variable virtual.

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