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Intelligent virtual environments for virtual reality art

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Abstract

The development of virtual reality (VR) art installations is faced with considerable difficulties, especially when one wishes to explore complex notions related to user interaction. We describe the development of a VR platform, which supports the development of such installations, from an art + science perspective. The system is based on a CAVE™-like immersive display using a game engine to support visualisation and interaction, which has been adapted for stereoscopic visualisation and real-time tracking. In addition, some architectural elements of game engines, such as their reliance on event-based systems have been used to support the principled definition of alternative laws of Physics. We illustrate this research through the development of a fully implemented artistic brief that explores the notion of causality in a virtual environment. After describing the hardware architecture supporting immersive visualisation we show how causality can be redefined using artificial intelligence technologies inspired from action representation in planning and how this symbolic definition of behaviour can support new forms of user experience in VR.
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1. Introduction and objectives

Virtual reality (VR) art has emerged in the last decade as an unexpected application for high-end VR systems as well as a new direction for digital arts [1,2].

However, the development of VR art installations is an extremely complex process. Leading VR artists have often benefited from a supportive technical environment for the development of their major installations. Some of them were able to hire teams of systems developers, while others were affiliated to academic institutions, which brought together artists and scientists or engineers. The level of complexity and cost of such development is certainly a limitation to the development of VR art. As such there is a rationale for new tools that would facilitate the development of VR art installations. However, the strategy for creating such tools has to be carefully considered, as one can only feel bemused at how diverse the relation to technology is among various artists. Some advocate a strong technical involvement and even participation in programming tasks while others tend to follow a production model in which technical developments are subordinated to the artistic objectives. This makes the prospect of generic tools rather unrealistic. Another approach consists in observing that often-artistic concepts revisit fundamental aspects of interactivity, or question essential concepts

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such as reality, physical experience or even the perceived nature of life. In other words, as these interrogations also happen to be scientific ones, they open the way to what has been recently described as the art + science approach, in which VR artists have otherwise played a prominent role. In this paper, we describe such research, whose aim is to facilitate the development of VR art installations in an art + science context [3].

This is why, rather than simply developing a "toolkit" to lower the accessibility threshold of VR art technology, we propose a system where artistic and scientific simulation can meet at the level of conceptual representations, while still generating technical output in the form of implemented VR installations.

2. Intelligent virtual environment: knowledge layer and programming principles

The notion of "behaviour" of a virtual environment normally encompasses all reactions of the environment to the user's physical intervention. This in turn corresponds to the physical processes triggered by the user, when for instance s/he grasps, then drops an object. More often, it will consist of all devices' behaviour that are ultimately not derived from physical simulations (for obvious reasons related to optimal levels of description), but scripted within the system's implementation. In both cases, such behaviour is encoded procedurally and the concepts underlying behaviours (e.g., patterns of motion, physical concepts, etc.) are not explicitly represented other than through variables embedded in equations or scripts. VR art is often concerned with the creation of virtual worlds that exhibit idiosyncratic behaviours, which might violate the traditional laws of Physics, such behaviours often being described in the installation briefs in abstract or metaphorical terms only. This makes it rather tedious to implement non-standard behaviours directly in terms of the low-level primitives (physical or procedural) that animate the world objects. This process could be facilitated if behaviours could be described at a more abstract, conceptual level, in the VR system itself. The creation of alternative behaviours could take place directly in this representation layer, which would also support iterative explorations of initial ideas. The use of an AI layer to define the behaviour of a virtual environment implements the notion of an intelligent virtual environment [4]. This experimental technology should bring numerous benefits to the development of VR art installations: it supports the redefinition of non-realistic and alternative behaviour from first principles, it allows rapid prototyping and experimentation and, finally it is well adapted to an art + science approach as it explicitly represents those concepts that are the object of artistic or scientific experimentation.

3. The illustrative briefs

To illustrate the technical presentation we will use examples from a fully implemented artistic installation, "Ego.geo.Graphies" by Alok Nandi. This brief is situated in an imaginary world governed by alternative laws of Physics [5]. The Ego.geo.Graphies brief is exploring interaction and navigation in a non-anthropomorphic world, blurring the boundaries between organic and inorganic. Its installation involves an immersive VR world with which the user can interact. The virtual world comprises of a landscape in which the user can navigate, populated by autonomous entities (floating spheres), which are actually all part of the same organism. In this world, two sorts of interaction take place: those involving elements of the world (spheres and landscape) and those involving the user. The first type of interaction is essentially mediated by collisions and will be perceived in terms of causality. The second is based on navigation and position and will be sensed by the world in terms of "empathy", as a high-level, emotional translation of the user exploration.

Through the staging of the Ego.geo.Graphies installation, we are interested in exploring aspects related to predictability/non-predictability and hence some kind of narrative accessibility, from the perspective of user interaction. On one hand, this brief is an exploration of the notion of context through the variable behaviour of the environment which itself responds to the user involvement. But on the other hand, it constitutes an exploration of causality. As such, it requires mechanisms varying the physical effects of collisions (bouncing, merging, bursting, exploding, altering neighbouring objects, etc.), taking into account the semantics of the environment.

This also implies that we explore how the user can be affected by causality. The spontaneous movements of the spheres focus the user attention, within the constraints of his/her visual and physical exploration of the landscape. The user will perceive consequences of spheres colliding with each other, which are equivalent to an emotional state of the world (as these multiple spheres still constitute one single organism) responding to perceived user empathy.

As a consequence, a dialogue should emerge from this situation: user exploration will affect world behaviour through levels of perceived empathy, and in return the kind of observed causality will influence user exploration and navigation.

4. System overview

The system presents itself as an immersive installation supporting alternative worlds with which the user can interact and, through this interaction, experience the nature of the fantasy worlds created by the artistic brief.

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