The building as the interface. Architectural design for education in virtual worlds.

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Abstract. This paper focuses on architectural spatial design for virtual tridimensional learning environments through the lens of a case study. The work describes the design methodology of a flexible and interactive set of virtual constructions where the architecture itself acts as a dynamic interface whose spaces adapt to the activities that avatars carry out in their interior, sometimes interacting with them. This approach considers the multiple innovative parameters that have to be taken into account in the process of cyberarchitectural design.

Keywords: Metaverses, Virtual Worlds, Cyberarchitecture, V-Learning.

1 Introduction

"We are on the extreme promontory of the centuries! What is the use of looking behind at the moment when we must open the mysterious shutters of the impossible?"
Filippo Marinetti. Manifesto of Futurism (1909)

Throughout history, technological changes have contributed to generate strong cultural and social changes. The "digital revolution" that arose from ICT's produced a profound transformation in the way people live, work and learn.

The number of virtual worlds is increasing day by day. Millions of users make practical use of virtual worlds for communication and as a mean for developing a wide range of activities [1]. Following this growing trend, an increasing number of educators and organizations make use of virtual worlds to create teaching programs and learning activities [2, 3]; that employ virtual architectural spaces that emulate their real equivalents.

Usually, the architectural design of virtual facilities follows the same compositive an organizational rules that are used in the design of buildings in the real world. That is commonly done as an easy way to provide the user with a reference frame which looks familiar to him by the use of well-known building typologies. The lack of background in architectural design of the vast majority of virtual world designers also plays an important role in this direction.

The design of such virtual buildings can follow very different rules than those used in the architecture of the real world, but in spite of the large number of cases of virtual constructions used for educational purposes that can be found, examples of research under the perspective of their architectural design are almost nonexistent. The literal translation of the real world architectural language to the virtual worlds is becoming a burden that delays the raising of new formal languages which should be exclusive of the virtual realm.

Those innovative aspects of the virtual medium constitute a field for research and experimentation in architectural design. Cyberarchitects can get rid of rules and limitations of the real world such as gravity, weather or even the rules of Euclidean geometry, being able at the same time to associate behaviors to the contents they create, thus allowing the interaction of the user-avatar with objects and the environment.

There are many concepts in the field of cyberarchitectural design that do not have an equivalent in the architecture of real world; some refer to new properties than can be found in the virtual building itself, such as immateriality, the possible absence of gravity or the mutability of shapes and materials. Other concepts relate to the avatar, such as anthropometry (even for non-human avatars), ability for flight, or spatial location of the avatar's camera. Those aspects are also important in the design of the virtual buildings and urban spaces intended to host interactive educational activities.

2 Objectives

This paper deals with several aspects of spatial design of virtual tridimensional learning environments by means of a case study: a virtual world, named "Isla Videa", built in Second Life which emerged as a formal response to the need of implementation of a virtual site for a master degree in the authors' university.

Two courses, with a duration of 25 hours each, on the topic of tridimensional interactive design, were given in cyberspace with both professors and students from different geographical locations being there through their avatars. This courses were part of the "Master on Digital Creation and Communication" offered by the university.

Considering the aforementioned concepts, the design of those virtual facilities sought to obtain a flexible and interactive learning environment inside a dynamic architecture, with responsive spaces capable to mutate in order to adapt to different activities. This research considered the multiple new parameters of this kind of architecture that can be now taken into account in the design process. The building experience itself represented a challenge for the authors-architects, since they had to work together in the virtual environment from two different physical locations.

The subject of the courses was "Interactive 3D design". Twenty students and four teachers took part in each experience, all of them located in different physical places. Aside from the educative goals of the project, the virtual environment served as a test bed for the interactive 3D contents created by the students.

3 Methodology

The process to implement these virtual facilities was divided in four interrelated stages: definition of parameters of spatial design; interaction design; building of the architectural model and usability test. This can be considered an interesting mix of the processes of creation of two apparently distant disciplines such as the architectural design and the creation of digital interactive contents.

3.1 Definition of parameters of spatial design

Cyberspace is rich in singular concepts that can be of use in virtual architecture design, expanding the creative limits of the cyberarchitect. There were two important key concepts, immersion and presence, inherited from Virtual Reality and related to space perception [4] that played an important role in the design of Isla Videa.

The initial sketches were drawn based on the analysis of the movements and trajectories of the users inside the metaverse as a mean to define the spaces, the limits of the buildings' skins and the behavior of the different elements that compose this project. Many aspects of cyberarchitectural design utilized in this case have already been described by the authors in previous publications. [5]

The study of circulations includes criteria derived from the flight capabilities of the avatars and the use of teleporting. Hence, the different proposed pathways act in this project as helpers for orientation, defining at the same time the zoning for activities.

The absence of predetermined physical laws in the metaverse make possible to create floating, weightless architectures, without the need of structural elements such as pillars or beams. Consequently, walls do not fulfill any supporting role nor they serve as a protection against climatic agents. Walls are used just to limit spaces and the activities which take place inside them and to control visual permeability.

This medium also enables the mutability of shapes to interactively adapt to user's needs. That results in designing volumes and skins for the buildings with a flexible behavior which can also display variability in their materials like changing colors or transparency, morphing textures, etc. Text, video, sound and web content can also be used to define the materiality of a constructive element.

3.2 Building the architectural model

The design of Isla Videa starts from the idea of the utilization of architecture as an interface for the dynamic organization of space, where the virtual building respond to the avatar's needs as he or she carries out learning or social activities.

Based in such premises, the project unfolds from two structural axis: a water course that crosses the island from North to South defining two large zonings of activ-

ities which materialize in the form of two platforms and a belt, or pathway that runs Southeast to Northwest integrating transversally all activity zones (Fig.1).

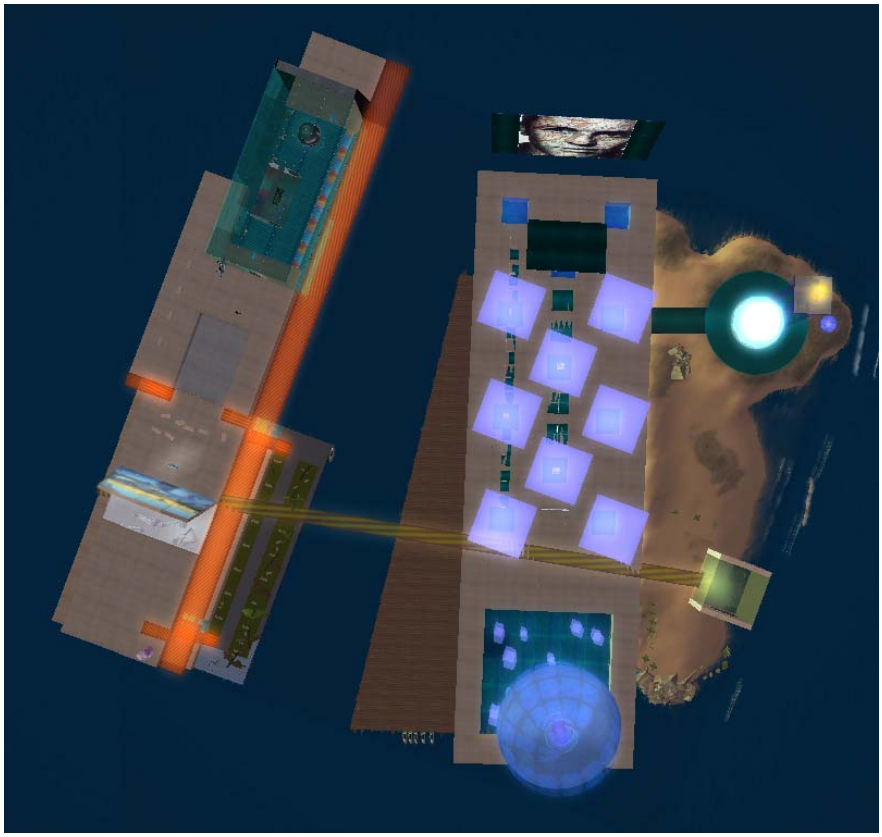

Fig. 1. Overview of the project

Platforms are organized based on their main use. On one side the one corresponding to the Main Building, and the Exterior Classroom that takes the shape of a floating flat volume covering the FlexSpace located underneath, whose name derives from the shapes that it holds and its use.

Crossing the watercourse one arrives to the Sculptures Field, a large area designed to host exhibits. Over this area, several floating platforms hold the personal working space for students. A big sphere suspended in the air acts as Entry and Welcome Point. Annex to this platform is the Deck over the channel on one side and the Beach and the Auditorium on the other side.

The majority of the built elements that constitute Isla Videa, from the buildings to the urban environment support some class of user interaction through LSL scripting. For instance, part of the pavement of the Exterior Classroom (Fig. 2) raises on de-

mand and swings until it is transformed into a giant display where teachers and students can drop graphic contents to share and discuss during the course activities.

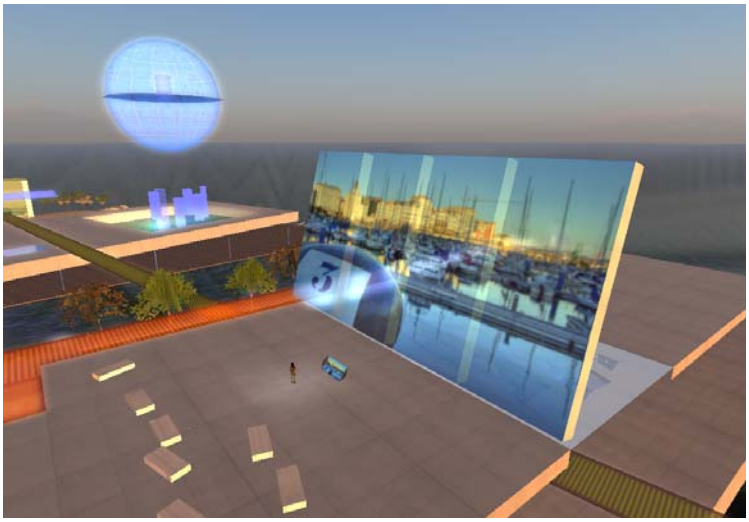

Fig. 2. Exterior Classroom

Fig. 3. Main Building. Interior space

The transparent box that gives shape to the Main Building is as a permanent visual link among the different spaces of the project (Fig. 3). This building is used a neutral container for multiple activities. Entering the building, the user attention focuses on two suspended elements, the Floating Classroom and the Mediatheque, both situated

over a lower level dedicated to creative activities and audiovisual exhibition on screens activated by user's presence.

A network of teleporters permits the transport among the different elements, as it similarly happens throughout the island.

Fig. 4. Floating Classroom

The Floating Classroom, shaped as an ellipsoidal cylinder, is a self-enclosed space designed either as a meeting room or as a classroom for small audiences. The element is defined by an exterior skin of constantly varying appearance while from the interior behaves as a translucent object. Lattice windows in both edges allow the users to watch the activities taking place underneath. It has no door, since access and exit are done by teleportation.

On the inside, the room is equipped with a multimedia table that can be used to make presentations to all avatars seated around it. Once the activity is finished, it can be stored. For this purpose, table and seats fold together and the set transforms into a decorative lamp attached to the ceiling. (Fig.4).

The black sphere of the Mediatheque, with interior walls that seem to be made of textured light; host the information containers that hold the course notes, resources, assignments and documents of teachers and students (Fig.5).

Fig.5. Mediatheque

Exiting the Main Building and using the teleporting network, the lower platform can be accessed. This zone contains several morphing spaces generated by the movement and continuous change of shape of several video screens, like cloths that twist and fold under the influence of user presence and the wind. Those FlexiSpaces are intended to integrate art, music and audiovisual works.

This area is bordered by a Reactive Garden, whose plants react to the user presence and movement changing their colors. The pavement follows the steps of the avatar illuminating its tiles on every step. The end of the garden is presided by a kinetic sculpture made of primitives and particle systems.

Crossing the watercourse along the walking belt, the pathway ends at the Auditorium over the sea, which is resolved with simple formal elements, but using the "ghost" feature available in the system to model the seats, so they can be crossed through to reach directly the seat desired instead of the classic row-column movement.

Fig.6. A class in the Auditorium

The Sculpture Field completes the island. It is made by a combination of cubes of light and opaque materials forming a large open space to display academic works and host temporary exhibitions.

3.3 Interaction design

One of the advantages of the use of metaverses like Second Life or Opensim is the possibility to program behaviors associated with every geometric element by means of a scripting language. This allows multiple levels of interaction between the user-avatar and the virtual environment. Therefore, both the container and the contents can be modified anytime to adapt to new requirements.

Three kinds of interaction were established in Isla Videa: touch, used to manually activate events, like unfolding a projection screen; proximity, used to trigger events automatically, like door opening in presence of avatars and location, used to modify the shape or orientation of objects with respect to avatar's location, like in the cloth-screens situated in the FlexiSpace.

There were other modes of interaction not related to avatars. Objects could react to solar time, i.e. turning on and off the lights of buildings and lampposts at dusk and dawn. Some objects could also communicate with others, such as the presentation devices that teachers used to control the images displayed in one or several screens along the island.

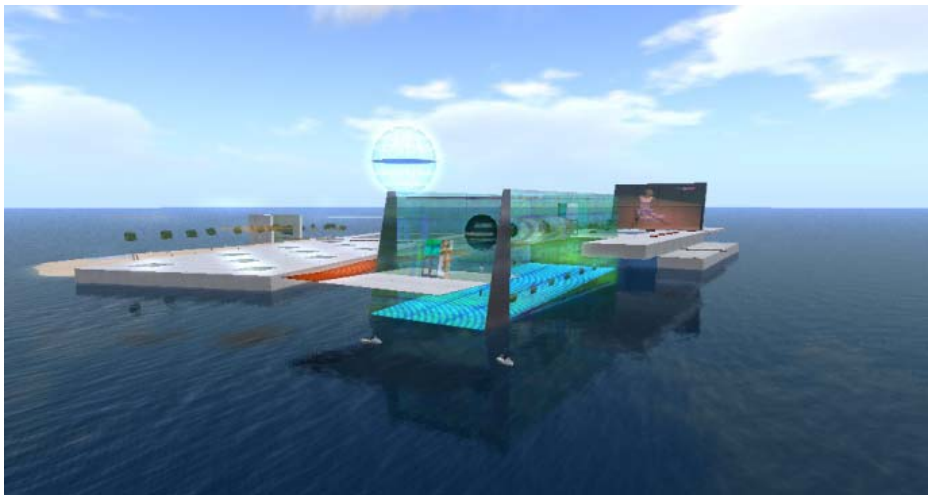

Fig.7. Overview of Isla Videa

3.4 Usability test and results

The project was tested in several ways. Two complete courses were carried out successfully in the virtual world. Both students and teachers highlighted the easiness to understand the organization of the virtual facilities and remarked the intuitive, yet surprisingly new concepts present in the architectural design.

Fig.8. Architectural 3D Award exhibition.

Isla Videa was also used to run a temporal exhibition of works submitted to the Architectural 3D Award contest [6]. A set of interactive exhibitors were designed to showcase pictures and videos nominated for the prize (Fig. 8). Those displays were responsive to the presence of the avatar as well, enlarging their content and playing the videos automatically when needed. Finally, the 3D Award ceremony was broadcasted from the real world to the virtual facilities, so the participants were able to assist virtually, met and discuss despite of living in very distant places around the globe.

4 Conclusions

The exploration of new formal languages derived from the unique features of the virtual realm leads to the development of innovative architectural forms than can enhance the educational experience comparing with the use of building shapes that mimic those of the real world.

As technology advances there is every indication that in a few decades, computer simulation systems will be able to provide the user with sensations of virtual presence and immersion in an extremely vivid way that is not available today. There is little doubt the mission of Architecture and architects is to contribute their theoretical work, talent and knowledge to design the spatial experiences of future Internet users in virtual buildings.

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