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Laboratório de Sistemas integráveis
CAVERNA *Digital*

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**Something from another world will never terminate the
data:
Interactive stereoscopic video for immersive
environments**

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Abstract.

Stereoscopic video applications in CAVE's are just now becoming more popular instead of the usual 3D modeled worlds. This paper describes the study and implementation of stereoscopic videos for CAVE systems, providing a more realistic rendering approach while preserving immersion and interactivity.

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1. Introduction

Virtual reality is an area in constant development. VR applications do not follow any specific standard and they probably never will. With these applications it is possible to create a simulation of reality, a virtual one. Nowadays the use of such applications is restricted due to the lack of investment in the area, the few VR platforms available and the hardware cost, which is prohibitive. This way, few investors take a chance in funding the development of VR applications.

Applications often used include simulations made with the extensive use of 3D models. These models must be implemented through a tri-dimensional computer graphics programming language such as OpenGL or DirectX. The use of video applications in VR is fairly recent and not many experiments in this area have been made.



Virtual Mockups Application Modeling.

The use of interactive video applications is increasing quickly, as well as the research in that field. This is mainly caused by the rise of interactive television. Moreover stereo applications are always being developed and improved resulting in more effective ways in dealing with the human brain perceptions.

1.1 Objective

Establish a scientific concept for studying a language and interface for immersive videos through the production of an interactive immersive video.



Video projection simulation in a CAVE environment

This project has as its goal to merge the two applications, to develop all visualization and interactivity with applications related to the CAVE and to use tools such as 3D mice, trackers, gloves, among others, for interacting with stereoscopic videos.

1.2 Target Audience

The target audience of this project is people who are usually interested in immersive virtual reality experiments and content creators using alternative procedures and new media.

1.3. Metodology

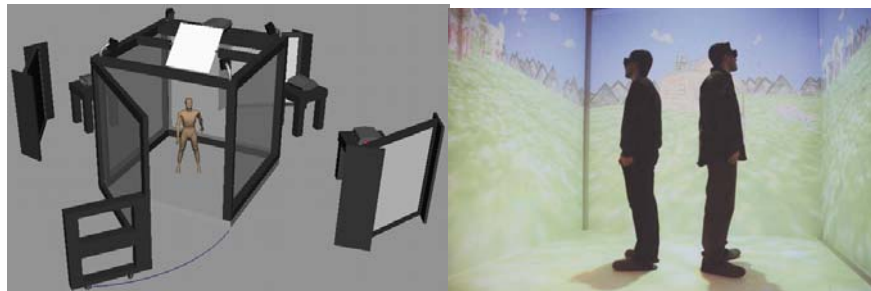
The project began with the study about existing reviewed applications for caves, published on www.cavernus.com and other universities sites, such as Illinois University where the first CAVE was built. In this study, it was noticed a lack video applications for CAVE environments.

The development of a video application for the CAVE environment was chosen due to the study above and to the video applications being developed by USP Ph.D. students (Glauco Todesco e Celso Kurashima) which are doing research about MPEG-4 video and real-time interactivity for CAVES.

A preliminary version of the application was based in a visualization software for computer clusters called JINX, developed at LSI by Luciano Pereira Soares, a Ph.d Student. (details on chapter three).

1.5 Hardware.

“CAVERNA Digital” is multi-projection virtual reality system. It is formed by five adjacent screens (walls) assembled as a cube. This system is able to display high resolution synchronized images originated from the same database, providing full user immersion in a computer generated virtual world.



Virtual Model

Demo of Application

Open in 2001 in the Electrical Engineering Department of the Polytechnic School of The University of São Paulo, the “Caverna Digital”, a cubic virtual reality system that provides one of the highest levels of immersion. One of the advantages of a cave system is its flexibility, allowing multiple users to share the same environment, limited only by its dimensions and the amount of active stereoscopic glasses available.

2. Stereoscopic Video Projection

2.1 Introduction

Stereoscopy allow us to see three dimensionally, we can see the depth of things. This sense of depth is caused by the eye separation, making you see slightly different images with each eye.

Based on both images, our brain is capable of distinguishing which object is near or far.



Projeção Passiva

Stereoscopic video projection has been around for a while. Although it has never been used on a daily basis.

One of the methods of stereoscopic viewing is passive stereo: the images for both eyes are projected at the same time on a screen. The light coming from the each one of the projectors is polarized either horizontally or vertically, but matching the filter on the user glasses. This way the image intended for the right eye cannot be seen by the left eye due to the different polarization of the light.



Óculos com filtro polarizador para projeção passiva.

For a higher sense of immersion caves usually uses active stereoscopy system. These images are displayed at 120Hz frequency and infra-red emitters switch at the same rate sending signals to the active glasses. This signal controls the light that comes through each of the glass lenses. This way the images for each eye are presented in sync with the emitter signal and the LCD lenses are in sync with the emitter signal, open or closed.

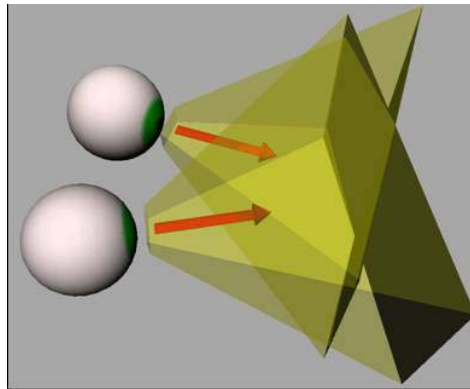


Óculos e sensor de sincronismo para sistema de projeção ativa.

2.2 Stereoscopic Video Capture

For a stereoscopic video capturing system two cameras are needed, each one representing an eye and the sequence of images being captured has to be synchronized.

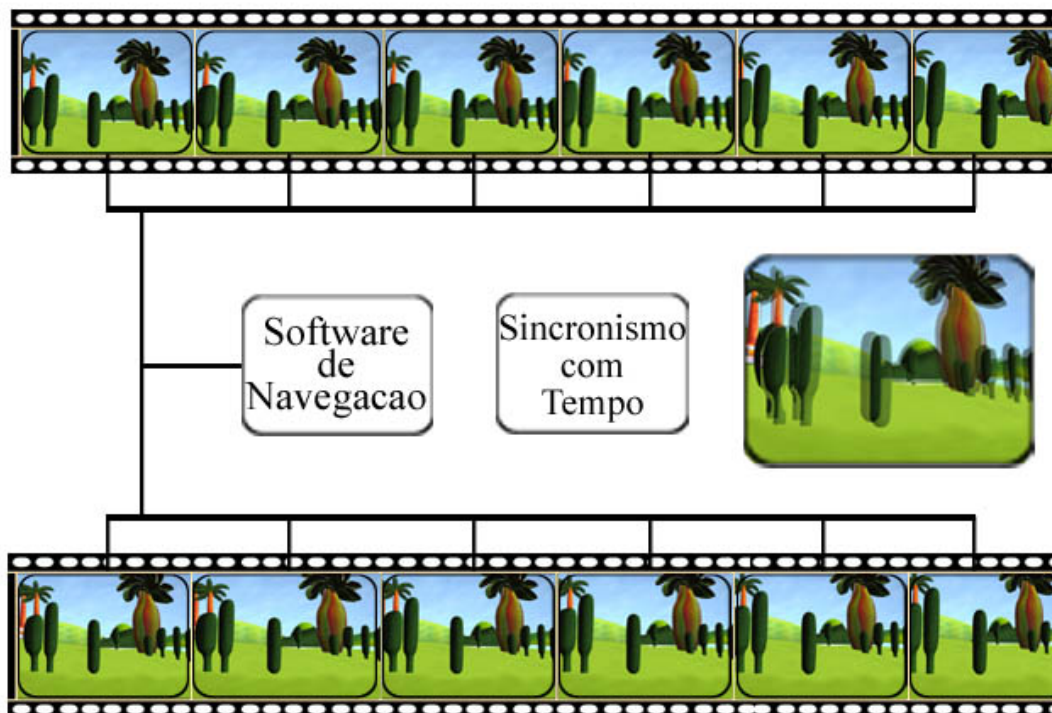
The most relevant technique for this application is the Toe-in, where the cameras are separated and slightly rotated to the center. The point zero will be defined where viewing planes intersect.



Various tests, with different techniques, for high quality synchronized video capture were performed. Compatibility with the visualization software was also taken into account. The best result was obtained using the MiniDV digital video format, which has almost perfect image quality and some sync issues. But those issues can be solved with any nonlinear editing software.

2.3 Techniques of Projection

The video projection techniques were performed according to the restrictions of the browsing software (JINX), splitting the two sequences of frames, (the two videos) from the images of each eye, in separate files. The video sampling will be done by a synchronized linear time shift of the frames for each eye and for the active stereoscopic projection with glasses.



Exemple of passive vídeo projection

3. Browsing Software.

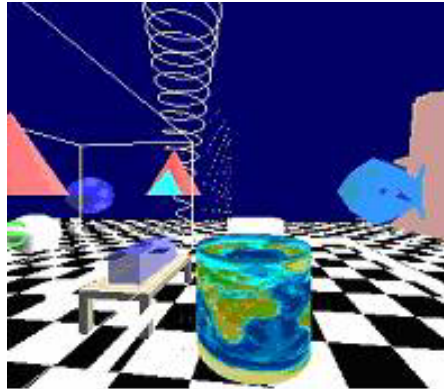
3.1 Introduction

Due to the high competition the electronic industry is accelerating the pace in hardware development. Who gets most of it is the end user which can take advantage this more sophisticated and less expensive hardware, creating and developing his own ideas.

Among the relatively cheap systems that can be built today are the Graphical Computer Clusters that are made of commodity hardware and software that can be easily acquired and maintained.

One of the most recent cluster projects is the Virtual Reality Cluster (VRCluster) developed by researchers at the “Laboratório de Sistemas Integráveis (LSI)”, that is a commodity computer cluster specially targeted to satisfying the graphical computing needs of immersive virtual reality applications.

The *JINX* application was developed by the researcher Luciano Pereira Soares. This application is capable of managing the VRCluster and displaying content to be visualized in immersive environment like CAVES.



Ambiente projetado no software *JINX*

3.2 Scene Description Format

X3D is the file format used by the visualization software to describe the scenes. X3D is a standard being developed by th

Web3D Consortium, as an open standard to extend and replace the features of VRML97. This is being done using XML.

X3D was conceived to provide content for and handling several systems like CAVEs, gloves, panoramic displays, stereoscopic glasses, 3D mouse, HMDs. Although it can also be used with regular computers with 3D support.

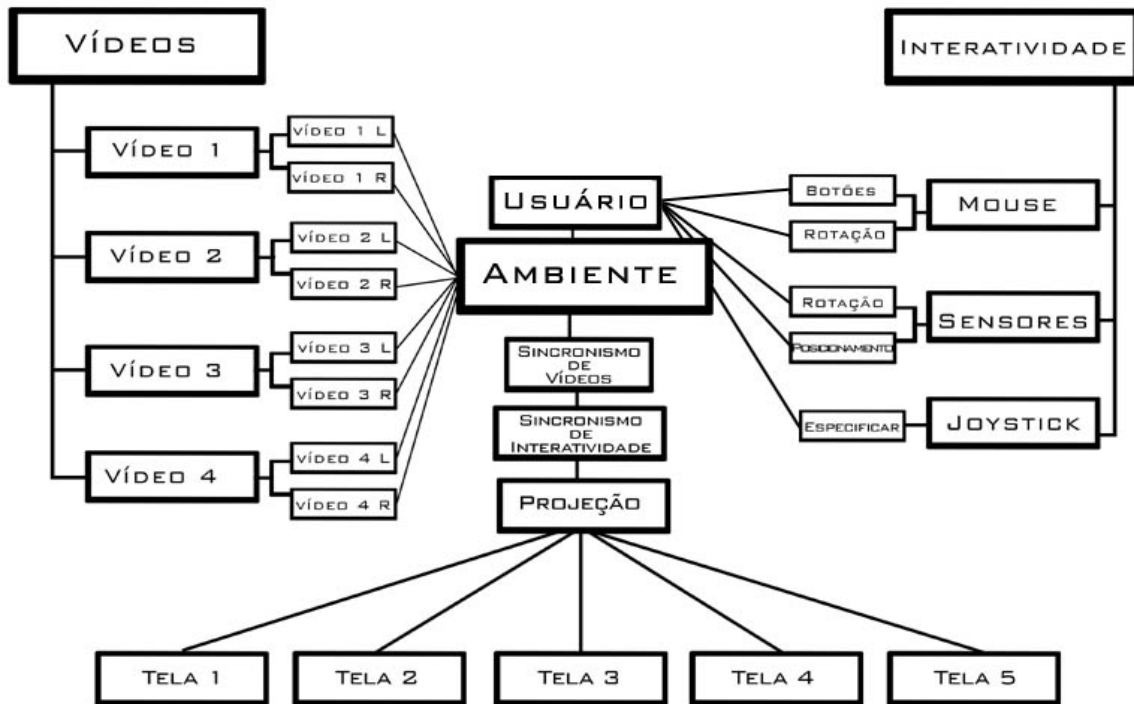
X3D tries to cover all of the most important virtual reality areas like 2D and 3D graphics, animations of various kinds, sound spatialization, interactivity and physical simulations.

3.3 Interaction Devices.

The X3D, the file format used by the JINX application, is a very flexible programming language where any kind of interactive device can be attached (represented). This includes: joysticks, gloves, head trackers and haptics. It is only necessary to configure how the data sent through serial or usb ports should be read and how they should interact with the environment.



Some Interactive tools : Joystick, Haptic, Spaceball and a Motion Tracker 3D.



Data architecture.

4 Creation of a Navigating Environment

The characteristics of the artist Escher and the reasons leading to the choice of the work “Other World”, as a navigation base setting in virtual environment, the artist’s characteristics in general of how Escher’s images and graphic computation have been merging in order to give final result of this job

4.1 Virtual Escher

For the navigation virtual environment creation to the bottom of stereoscopic video projection, it was necessary works inspiration that would bring different realities, ”impossible images” ,in strange perspectives.

The Escher choice for the virtual environment model, occurred due to images created by him, theoretically impossible, but in a virtual world everything is possible, even what it seems to be impossible.



Figure 1 - Other World, inspired work for a navigation environment creation.

The Escher “Other World” work was the more similar with the project because of its visual esthetic and details combination, among them, the Mallarmé poetry

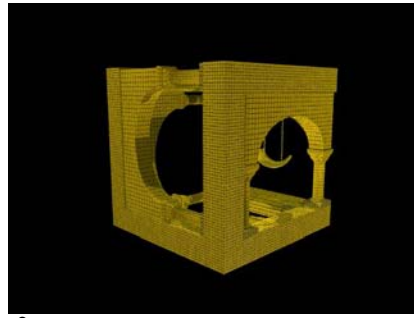


Figure 2 - Escher work modeled in 3D for navigation start.

5 Navigating Through the Mallarmé Words

The poet Mallarmé 1842-1898 France. A symbolist creator of a “Mallarmeanean” school. His texts are considered abstractionist symbolist, where the words disposition are part of the expression, “...the first words of a poem, as the next, the way they are, lead to the last, the whole without novelty but a reading spacing...”¹ Every poetry has logical structure, in the words disposition, and even in the blank spaces”...the blanks, with effect, assume importance, are aggressive at the beginning, the verses required, as silence, ordinarily, until the point in which a fragment, lyric or, in the center, the third of the page or more...”¹

Mallarmé and his proposal of a book which poetries would be built by chance by the reader, is often reminded in these analysis. Not exaggerating on continuance, rupture importance and the novelty emergency, we have to consider that we may notice art tendencies in the xx century that purposed kind of deregulation of artistic work, and certain language innovation, and now what is presented as

esthetic manifest seems to put art concept itself in the line, on the other hand, it is necessary to question whether communication technology novelties emergency modified radically the modern artistic language.

5.1 Mallarmé Virtual Poem

Interactive digital media experiences are very restrict ,in such case, the theoretical basis acquired are very little, although the basis are followed by technical lines with manifest that try to escape from conventional, creating new concepts.

“The interactivity has been one of the main topics discussed in relation to electronic experiences. There are many authors considering that interactivity was a proposal from the new artists and that it was present in famous authors works, as Mallarmé”.²

The proposal of Mallarmé in the poetry “Turn of the Dice” proposes the reader interactivity in a hypertext environment, anticipating the typical schemes from virtual era, unveiling works as construction process always to be done.

This poetry brings several sequences possibilities like any work that is interactive and is presented in new medias.

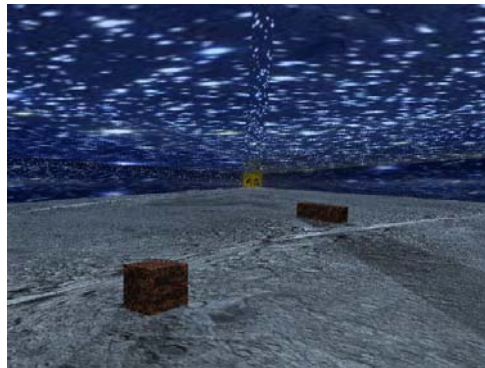


Figure 3 - Navigation Environment where poetry key words will be spreaded on it, as a stereoscopic video link.

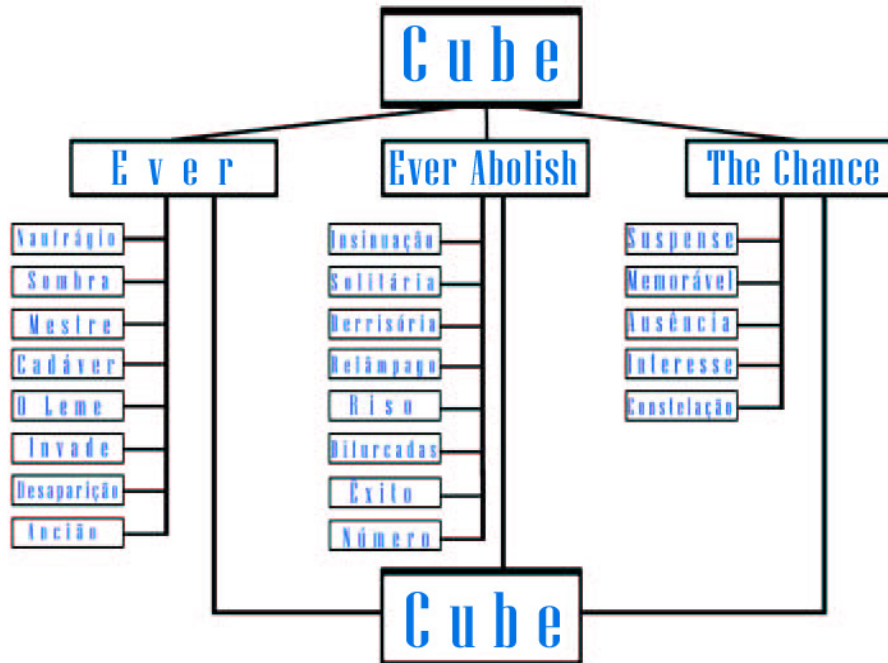


Figure 4 - Key words related to each video link.

6 Conclusions

The virtual reality systems are evolving at each moment and the applications in immersive environment are being used more and more, and with this project conclusion, a new research starts to be concretized, trying to change the ways virtual reality is seen, offering a new language for the rise of new concepts in Interactive Stereoscopic Videos Projections for Immersive environments.

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M.C. Escher "www.mcesher.com", site oficial da fundação escher (Escher Foundation), com todas as obras e biografias do autor.