

# VideoSpace: a 3D Video Experience

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**Abstract** — VideoSpace is a 3D interactive video environment that allows the visualization and navigation of videos in an information space, organized around semantic cultural aspects, down to the individual video level, where we navigate around and inside the 3D video pixels, in ways that allow to capture cultural relations in different countries and to experience and influence the expression of their intrinsic aesthetics.

**Index Terms** — Art, color, interactive systems, three-dimensional displays, video, visualization.

## I. INTRODUCTION

Video is a very rich media type, combining diverse symbol systems, such as pictures, texts and narration, into coherent media messages. It has been used in different contexts: as a way to capture and show real events, to visualize dynamic processes not observable in reality, to tell stories and entertain, as a means of communication, and to capture and share our culture. Visualization may help to express this richness in information spaces.

In art, video made its first moves in the mid 1960's [12]. Video art [5,11,16] has a broader goal than experimental cinema and film, spanning from exploring the boundaries of the medium itself to attacking the viewer's expectations of video shaped by conventional cinema. Many of the early video artists were involved in conceptual art, performance, and experimental film, others were interested in the formal qualities of video and employed video synthesizers to create abstract works. Recent video art works include entirely digitally rendered environments and video that responds to viewers' movements or other properties of the environment. Video can be presented in a single screen, or in an installation involving an environment including several pieces of video presented separately or in a combination with traditional media.

Artists express their creativity in ways intended to engage the audience's aesthetic sensibilities or to stimulate mind and spirit, sometimes into unconventional ways of seeing and perceiving the world. In digital art, art is created in a wide variety of approaches, contexts and experiences including: interactivity, non-linearity, multimedia, virtual and augmented reality, net communications, databases, and 3D visualization, often presented as art installations, where viewers may become participants in the art making process [6, 13].

VideoSpace explores interactive 3D visualization and navigation of video at different levels, allowing to explore cultural relations among the videos and to experience and influence their aesthetic properties. Section II presents VideoSpace in more detail, followed by a guided tour in section III. Section IV presents related work, and the paper ends in section V with some concluding remarks and perspectives for future work.

## II. PRESENTING VIDEOSPACE

This environment allows to visualize, explore, navigate and experience videos in 3D. At the global level, the MacroSpace, several videos are presented; at the individual level, the microSpace, one video is accessed. The user may navigate inside and out between the two spaces. In this section, we present these spaces and the way a user can get inside VideoSpace. We refer to the different modalities available for interaction and to how videos can be added to the space.

### A. Video MacroSpace

Videos are organized around a 3D globe in accordance to a semantic classification, for example their theme or country, which the user may choose. Videos from the same category are linked together by a vibrant light bolt starting at the center of the globe to the first video, then around its frame and to the next video. These links have a different color for each category, making it easier to visualize relations among videos.

Each video is presented as a loop of a few of its frames, showing, in an efficient way, a summary of its content and suggesting that it is a video, not a still image.

Videos are visualized around a globe, adopting a world metaphor with vibrant light links, with an aesthetics that inspires movement and invites for action. The user can navigate this space by: spinning the globe in different directions; zooming in or out; moving inside and out. From each video, the user may obtain additional information, or select it to set the focus and navigate at the individual microSpace.

## B. Video microSpace

A single video is represented in 3D. Pixels take the shape of quadrangular prisms, in the original color, with their height reflecting brightness. As the video plays, pixels change color and height accordingly, brighter pixels standing taller. The user can: increase or decrease resolution, by changing the number of pixels; enlarge or reduce the image, by changing the size of the pixels; spin the video in every direction; zoom in and out; navigate among and around the pixels, having perspectives from the inside or the outside. In fast movements in or out, the video appears to explode or implode.

It is possible to have the original video shown in small as a reference, at the same time, or just stay with the video representation. As the user gets more detached from the original video image, by changing pixel size or navigating inside the video, the original image gets deconstructed and the user is led to a “more pure” aesthetical experience. Video becomes an accidental source of aesthetical properties, influenced by the user.

The user can navigate back to the MacroSpace, at any time, or select one of the pixels and drag it to the MacroSpace icon, colored with the last searched color. This will trigger a search by color, resulting in a presentation of the MacroSpace with the selected videos organized by the same categories as before, but ordered from the center by average color similarity to the searched color. The center of the world changes its color to the searched color every time. This way, the visual aesthetics of the MacroSpace is influenced by the user, and as a consequence, a new palette of videos is created to choose from and influence the next microSpace aesthetics. This will be especially evident, if the videos have a clearly identified dominant color.

## C. Getting the user inside the VideoSpace

The user is represented in the center of the world by a human figure, as the one responsible for defining the criteria to search and organize the video space, although he can actually navigate it more freely, as an observer, from any position in the space. In addition, this representation of the user is also a portal for her entrance into the microSpace, through her video, shot in real-time from a camera in the setting. Besides from all the navigation described, the user may now have a direct influence on the pixels’ colors and height, by moving or showing objects captured by the camera, and creating a 3D dynamic “painting” in front of her.

## D. Interacting with VideoSpace

Besides navigation through keyboard and mouse, the user can interact with the system through gestures detected by a robot. With the robot and video projection, VideoSpace is set as an installation, unaware of backstage computer equipment. We used a Hemisson [8] robot with eight sensors activated by proximity. The two vertical sensors allow moving along option lists, while the six horizontal sensors control navigation actions, like zooming or spinning in different directions.

## E. Getting Videos into VideoSpace

To get new videos into VideoSpace, we built an application that processes the videos to determine their average color, select the frames for the loops at the MacroSpace, and register them in the system, along with the attribute values for the different semantic categories used to classify the videos.

## III. A CULTURAL VIDEOSPACE TOUR

In this section, we will guide you in a small tour inside VideoSpace, to demonstrate some of its features. In this space, we present cultural aspects in videos from different countries: Portugal, Spain and Brazil, in themes that include music and dance, from different authors or artists. Videos were classified by country, theme and author categories.

In Figure 1, we are in the MacroSpace. Videos are presented in the globe, linked by the author category, and navigation is done by zooming in and out, and rotating in different directions. Note the traces left behind, reinforcing the movement aesthetics. From the last state, we chose a video from Luís Represas, a Portuguese composer and singer, and were led to the microSpace of this video, in Figure 2. Here we watch the 3D pixelized video, and navigate it by rotating and zooming in, getting the sense of an explosion, and we get inside surrounded by pixels that are enlarged a reduced, and finally we zoom out and rotate the pixels at high speed. We lose the perspective of the entire video image, and instead enter a space that provides an experience of color and movement, with a dominance of blue in this video.

In Figure 3, we are again in the MacroSpace. This time, we choose the sevillian dancers from Spain. We zoom in and rotate, we explode and then we implode the video, then rotate and zoom it back to full screen. This video is more colorful than the video in Figure 2. Also, note how the video resembles a painting in some of its states, representing the real image in a more abstract way, like in impressionism, emphasizing its light and movement.

Figure 4 illustrates the choice of a video in the MacroSpace, leading to the microSpace, where we chose a pixel to make a search by color - a soft cyan - by dragging it to the MacroWorld icon at the bottom left corner. As a result, we are lead to the MacroSpace, where the videos were selected and ordered by their average color closeness to the query color. The human figure in the center becomes this color and the video space shows videos with a dominance of this color. The choice made at the microSpace influencing the aesthetics of the MacroSpace.

Finally, Figure 5 shows a video that has high contrast among the pixels, resulting in a 3D representation with a significant difference in pixels' height, inducing a different aesthetical sense.

#### IV. RELATED WORK

Most related work is found in the areas of information visualization in 3D and video art.

Visual representation of semantic relations in information was explored for example in Similar Diversity [15], an art exhibition using information graphics to visualize the relations of holy books of five world religions, opening up a new perspective at the topics religion and faith. Relations represent different weights in accordance with semantic proximity. But it is not interactive and does not include videos.

Some applications allow us to visualize and interactively browse information in specific 3D domains, including those that follow the classic approach of Data Mountain [14] letting users place documents on a 3D desktop virtual environment. Also for documents, Above and Beyond [4] adopts an outer space metaphor for the file system, a more similar metaphor but still no special support for video files, nor the representation of semantic relations among them. Chon et. al. [3] present a method for the interactive visualization of 3D video mosaics representing roadside buildings, but not unconventional and less realistic visualizations of the videos, nor a video information space. VideoSphere [1] represents a video space around a sphere, with links among the videos, reflecting semantic compatibility  $y$ , and allowing to navigate around and inside and out the sphere. Videos are represented by still images. When selected, the sphere rotates to put this video in the center, where it can be played. Links are represented in black by static lines, except for the links involving the video in the center, which become red. The user may also choose to hide the links, or to access a list of topics, and from there reach the videos related to each topic. When selected from the list, videos are brought to the center of the screen by sphere rotation. Although more related to VideoSpace, the 3D

visualization is restricted to the video sphere, with the focus on exploring semantic relations, in a less dynamic way.

Artistic representation and visualization of video has been addressed by a few authors. For example, Hertzmann and Perlin [7] developed methods for painterly video processing, applying paint only on regions where the source video is changing, producing video with a novel visual style. In a related approach, Litwinowicz [9] explores pushing short brush strokes along scene movements in video, providing tools for edition and correction.

Also related is the area of Video Jockeying (VJing) [10], where a performance artist creates moving visual art, usually based on video on large displays, at events such as concerts, nightclubs, sometimes in conjunction with other performance art. VideoSpace can be used by such an artist, navigating the 3D space in real-time during the performance.

#### V. CONCLUSIONS AND PERSPECTIVES

We presented an installation featuring a 3D video space that explores new ways of visualizing and interacting with video. VideoSpace allows showing and exploring the cultural links among different countries, with their particular aesthetics, at the global and more semantic level of themes and authors, and at the micro and more syntactic level of color and brightness. At this level, we may reach a state where the video is deconstructed to the point that we do not recognize the original image, while navigating around or among the pixels. We are left to experience the new aesthetics of shapes, colors, light and movement, that we may influence – in this “new” video. We can also select a pixel at this level to issue a query for videos with a similar average color, influencing the aesthetics of the MacroSpace of videos.

In VideoSpace, we emphasize the navigation on the semantics of themes and countries and the search on the syntactics of color and brightness: the opposite of classic information spaces.

VideoSpace can be used in a traditional setting with a screen, a keyboard and a mouse, or as an installation with the image projected on a wide screen and interaction done by gestures detected by a small robot in front of the user.

In the future, we want to refine VideoSpace in accordance with users' feedback, and to explore other 3D representations of video, and more immersive techniques of visualization and interaction. Accessing videos available and shared in a wider context, like the Internet, is also an interesting perspective, but requires a more standardized classification of the videos. Web 2.0

technology and metadata standards may provide the basis. At the moment, VideoSpace is driven by interaction. A future version might explore some automatic navigation and evolution, following on our previous work [2] with evolutionary video editing. We believe we have created an engaging and enjoyable interactive visual experience based on unconventional representations and expressions of video, and identified new perspectives to take the experience into new levels.

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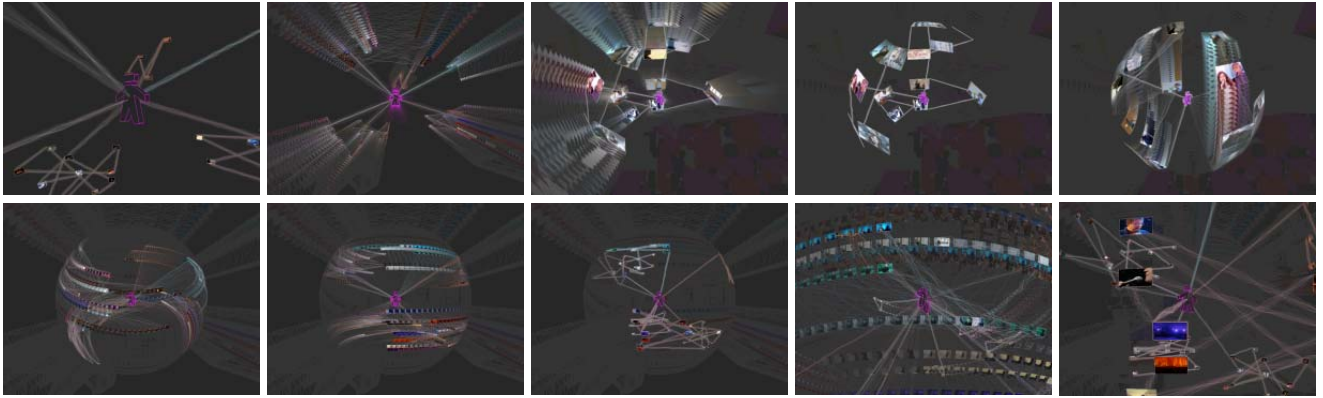


Fig. 1. Navigating the MacroSpace.

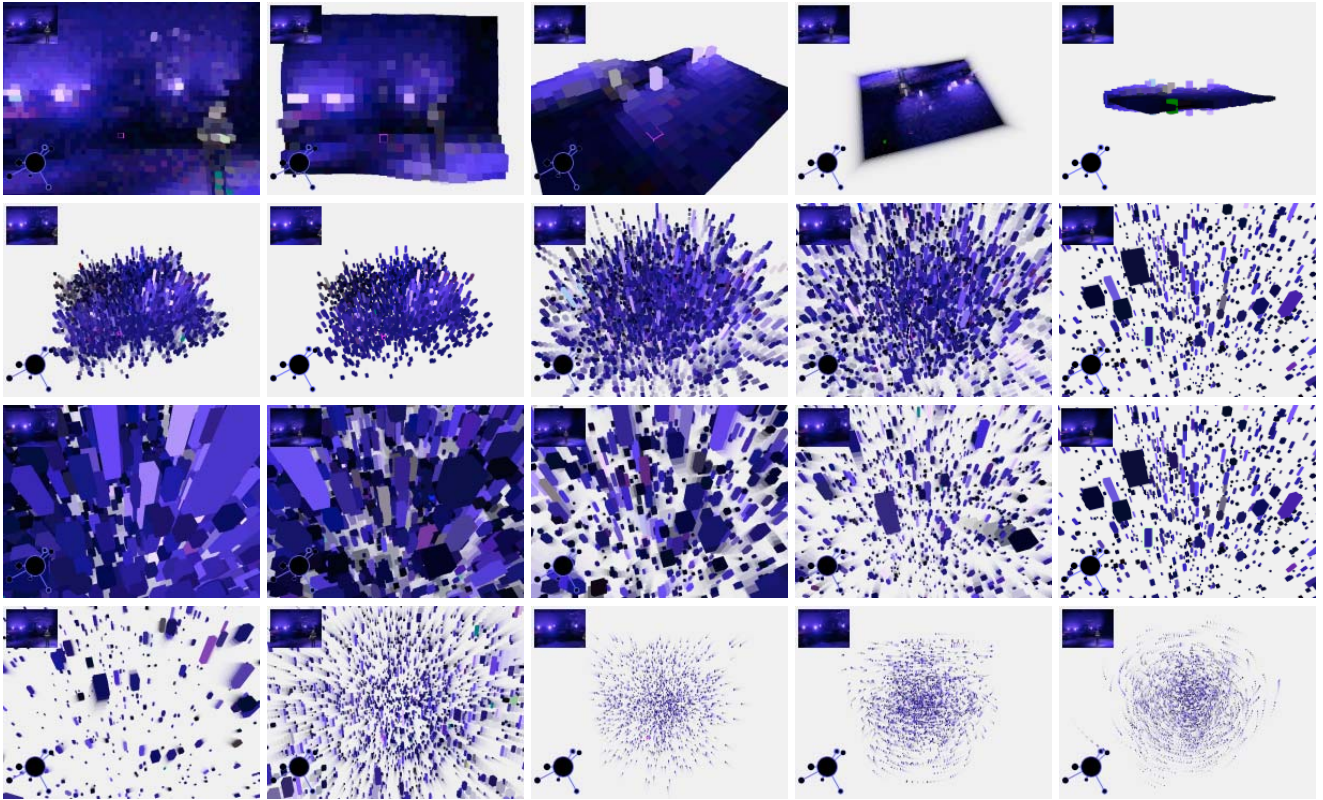


Fig. 2. Navigating the microSpace: a music video with dominant color blue.

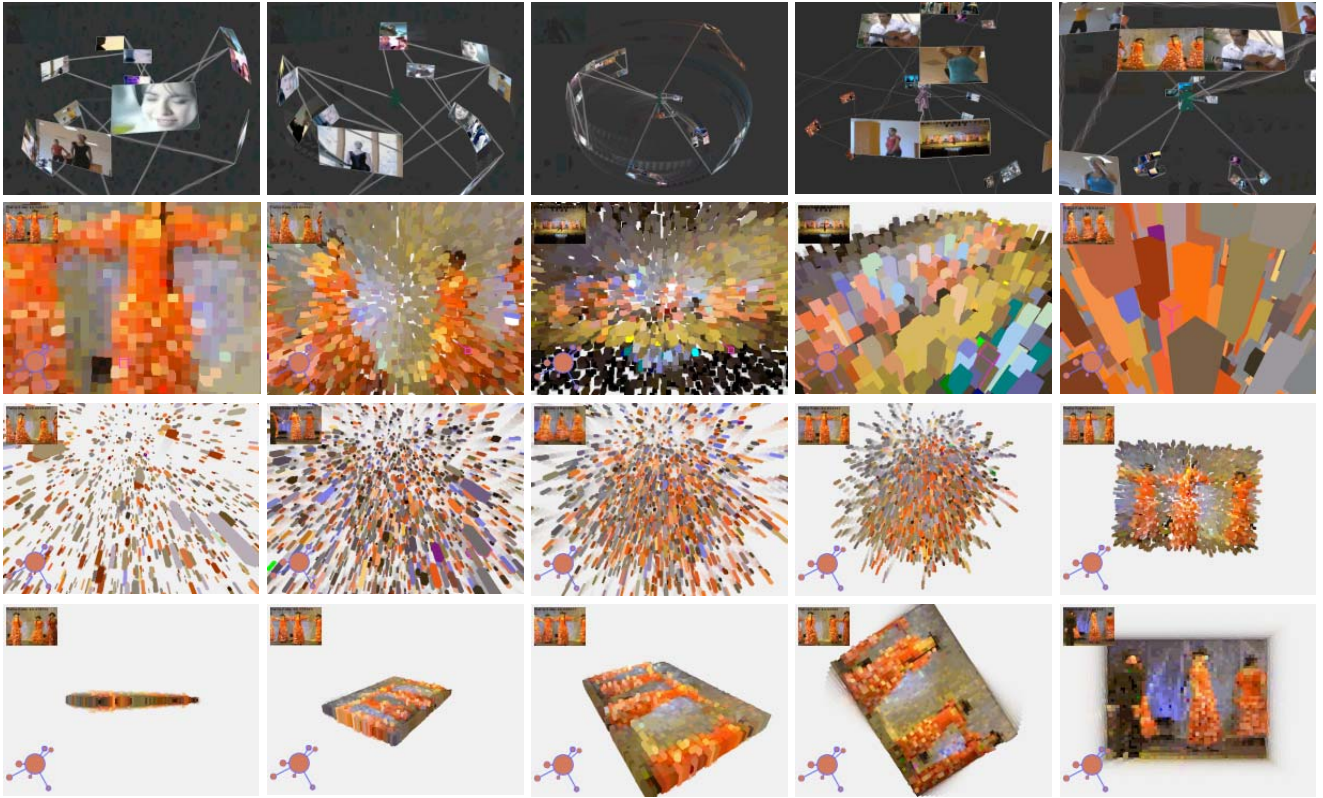


Fig.3. Navigating the microSpace: a colorful dance video.

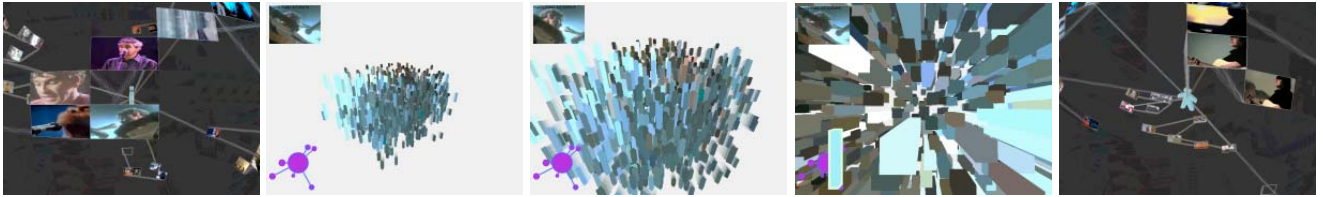


Fig. 4. Color choice in the microSpace, influences aesthetics of the MacroSpace.



Fig. 5. Accessing a video in the microSpace with high color contrast.