Digital Panorama

Multisensorial interactive environment for National Cinema Museum of Torino

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***Abstract*—In 1787 it was Robert Barker to invent the term Panorama, still used to today all over the world to determine a large view, up until 360 degrees. His show has traveled European cities and the American new frontier, letting visitors "enter" into far painted cities or ancient history episodes. The Cinema Museum, in the movies archaeology section, digitally proposes the same experience. A small cylindrical *cave* houses the Digital Panorama, a semi-immersive environment, which creates visual and audio panoramas and back in time journeys into Turin cinema history. The visual-tactile interface design is of note because it has been designed to be equally available both by blind and seeing people, as for the Cinema Museum philosophy "a museum for all". This paper illustrates the project critical points, the choices operated during the operating process and the interface reviews.**

***Index Terms*— Digital environment, Panorama, Usability, Cultural Heritage**

I. Introduction

In 2014 the Turin National Cinema decided to look for a comtemporary and digital version of the eighteen hundred century Panorama. The Cinema Archaeology Scientific Manager, since the very beginning, express the demand to combine philological contents and spectacular result. But the limited size room we disposed of was a serious restriction. Though similar installations have already been made in the past, such as Place-Hampi [1], T-Visionarium I/II [2] and the "The Guardian" web application from the top of new "shard" in London [3], the morphology of the available space and the type of interaction required have forced to develop "ad hoc" technological solutions.

II. History References

Robert Barker created the Panorama exhibition in 1787 "Fig. 1", and since then, the word itself became so popular and the neologism entered in all dictionaries of the world. [4] A large cylindrical structure has been built for shows in European and American squares, with 360 degrees painting inside, including the visitor point of view. The paintings rendered beautiful cities or historical episodes. The audience sit at the center, upon an elevated platform, to help the immersive feeling. It is the same principle of the contemporary cylindrical cave, except for the interactive action. Auguste Nicolas Nepveu, thirty years later, introduced a form of interactivity in our table *cyclorama*, simulating one of the first panning. Two spinning poles at the sides of a reel operating a painted stripe rotation, viewed through a central binocular system.

Fig. 1. Interior view of Barker's Panorama

Subsequently, they were developed the first experiments with 360° movie : the "Cinéorama" by Raoul Grimoin-Sanson (France 1897), the "Photorama" by the Lumiere brothers (France 1902), "Circle-Vision 360°" by The Walt Disney Company (USA 1955-1957), etc. . Over the past 50 years that have followed the digital experiments both with large cylindrical immersive environments (eg "Movie-Drome" dome theater by Stan Vanderbeek, "Landscape One", "Panoscope 360 °", "The Visitor: Living by Numbers, Where are you? "by Luc Courchesne," Sacred Allegory "by AES + F, etc ..) for both desktop solutions such as QTVR of Apple, which since 1997 has built the foundations for the current developments of panoramic photography of the mobile smartphones and the recent wearable devices

II. III. Project Targets

Digital Panorama (DP) was designed to enable user to explore both in visual and audio fashion the city of Turin panorama, as it would be seen about 100 meters high on the Mole Antonelliana. As for the standard QTVR experience you can both pan or zoom in. There are dozen hotspot to activate history black and white amateur video recordings of events in specific parts of town. The visitor experience is quite similar to the eighteen century Panorama, with the extra experience of personal interaction and back in time travel.

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IV. Environment Design

DP was to be built in a very little room: about 3x3 meter room for 4 meter height. The experience gained in industrial Modeling & Simulation fields, suggested to design a "cylindrical CAVE-like" system with multi-projectors screen, a complete surround audio system and hand tracking device solution. In the beginning we had three options: a three projectors solution (two on the sides and one in center position), a two sides projector solution and a one anamorphic cone projector solution. The two projector solution resulted the best since resulted similar to the three projector solution but less expensive. The anamorphic projection proved extremely interesting but allowed only Full-HD 1080p single frame resolution. In the end we decided for a double Full-HD 1080p, which means 3200x1200 pixel (blending included): appropriate resolution both for screened contents typology and viewer distance from the screen. Nonetheless many evaluations had been made for the two projector solution.

First of all the highest distance from the screen had to be established, in order to obtain the largest projected surface. On this note a short optic system (0,70x) was selected, and a circular shelf had to be built, invading the gallery space. But its roundness and dark shades colors, resulted in harmony with the DP design and existing architectonic environment. The shelf even insulates the projector system itself from outer disturbances. "Fig. 2"

The two OPTOMA EH 505 projectors are guaranteed for 24/7 working performance, minimal background noise and available with blending/warping software installed. The cylindrical screen has a wooden structure with black painted curved wooden panels finish. The visitor comes in approaching an interactive round table (accessible to people with disabilities) on a slightly eccentric position.

The audio setting is designed for a complete immersive experience. DP is equipped with a 5.0 surround system consisting in 5 *JBL Control 2P* active emitters, positioned about 2.20 meters high all around the visitor. *MOTU UltraLite-mk3 Hybrid* audio device setting compensates for the eccentric visitor positioning, and operates as amplifier, equalizer and surround manager.

The interface design, guided by the Museum claim "A museum for all", allows both for people with disabilities and not same usability model, without difference in approach or gestures. Therefore a curved glass surface has been developed with a Displax Skin Multitouch 34", double touch capacitive film applied at the deck bottom to obtain a large interactive area, active to single, double tap, pinch in/out.

The deck is a 15 degree inclined toward the user, both for highest accessibility and to avoid laying objects upon it, and is supported by two technical casings on the sides. It allow housing 3-4 people at the time and the eccentric positioning avoid intersection between visitors and beams from the projectors. "Fig. 3"

The extremities of the desk are built with two boxes which contain also the PC station.

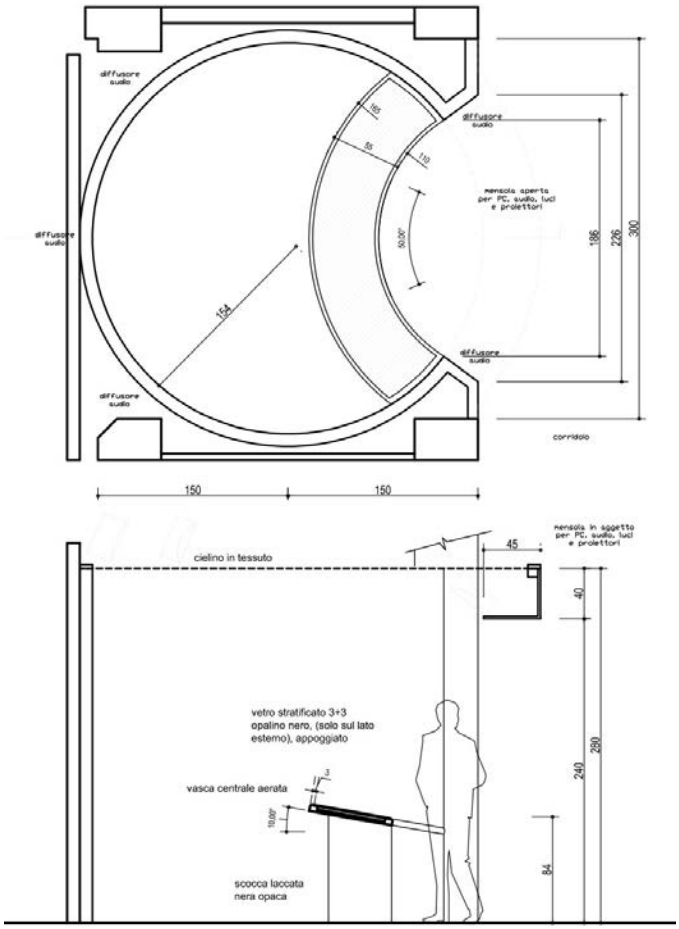

Fig. 2. DP design, built version. The audio surround system emitters are placed above the fabric ceiling

Fig. 3. The completed DP structure without the curved glass desktop

V. Architecture

The computer system is set by a standard performance PC, with i7 processor, double HDMI video exit, ATI R7750 graphics card with 3 Gb RAM on-board. The operating system is Windows 7, 64x, both device drivers and projectors managing software compatible: the Warpalizer allows blending and warping, mixing the projections at their mutual extremities. The warping and the focusing has been extremely hard to set, because of the screen curve. The Warpalizer setting demands technical proficiency. The reference grid results stretched on the horizontal dimension, requiring non square pixel video contents to balance. The projectors demand the utmost stability, since the smallest movement requires additional warping adjustment, requesting ulterior maintenance costs. It was not possible to use a warping/blending self-calibration system because the reduced radius of curvature that has required the creation of "ad hoc" grid to maximize the area of the final projection.

VI. The Touch Desk

The touch desk demanded further planning. Requirements were structural and software sturdiness because 600,000 visitors per year (about 1650 each day), exacerbate software bugs and structural damages. This user operable desk has been at the center of cooperative planning effort including different professional figures and subject to validation processes. The desk had to be elegant, evoking technology without showing it. It had to offer a touch screen surface easy to clean, multiple time a day. It had to be accessible to people with different types of disabilities. The solution had to work like an Apple Ipad touch screen with simple tap, pan and zoom in/out. And the drivers and API should be available for the most of the 3D engines and external devices. First, we thought instructions weren't necessaries, as the DP desk works pretty much as any smartphone on the market. Therefore only three gestures icons were applied on the desk: touch, zoom in/out and double tap for start/stop; without highlighting the sensible area. But the first month trial period, we monitored different dynamics than the foreseeable ones: some people began to act with much reserve, only touching the small icons instead of the whole sensible area; while other people, most used to their smartphone, operated the device without problems. Overall we monitored some difficulties in the fluid finger panning over glass desk. In the end, sacrificing a little bit of style, we placed a synthetic film over the glass, where we had printed graphic instructions, improving largely both fingering. The final result is extremely effective.

VII. Software Application

DP looks like a standard QTVR application; regarding visual aspects we can count on many instruments for stitching more than 9,200 pictures of the project and activate the multimedia hotspots. But, concerning audio aspects, we weren't able to find any tool ready to perform the requested tasks. E.g., PanoTools software allows to manage gigapictures and select audio contents all over the cylindrical space accordingly to their area of influence; but it works only stereo mode (2.0) but not audio surround (5.0 or more). We resolved to develop a 3D environment, using Unity 3D, consisting of 6 concentric cylinders, each textured with one gigapicture level of detail (LOD), referenced to a common North. Then we placed a virtual camera at the center of it. The user interaction drives the virtual camera movements: rotation over the Y axis (vertical) and movement over the Z axis (depth), defining zoom in/out movements. The audio environment presents more difficulties than the visual one, because the sound is not static as a picture. In DP the user discovers more visual details zooming and panning the panorama revaling and increasing sound details too. Therefore, we had to link specific sounds to specific areas, maintaining the balance of every sound in the panorama, simulating the experience of populated urban environment walk-through. Starting from the top of the Mole Antonelliana we made a recording of wind sound, to establish the first level of sound detail (LOD0), underlining the high altitude starting point of the exploration. Proceeding with the subsequent level of detail (LOD1), we made a 360 degree recording of the city overall sound from atop the Mole building. Then we identified more than a hundred sound locations the visitor would encounter in touring the city. We made loop recordings of vehicular traffic, pedestrian an bicycle traffic, people interactions, sport environment, working people, parks and nature sounds and specific landmark activities: opera music at Teatro Regio, concert at Auditorium RAI, TV jingles at RAI Headquarters, holy mass at the Basilica di Superga, and so on. We named these recordings "sound pills", and were referenced in virtual cylindrical space by XYZ position coordinates and, for each "sound pill", we identified a sensible area to define its volume in reference with camera position at that specific moment. This "sound pills" were distributed in between levels from LOD2 to LOD6. Unity 3D software is able to manage the sound spatial behavior, increasing or decreasing volume levels accordingly to the XYZ coordinates of the sound source and camera and blending correctly the mutual influences. Zooming in on a particular spot you obtain an increasing amount of detail both in sound as visually, and the used interface is the same: both people with disabilities as regular ones, and even blind people, share the same experience. "Fig. 4"

Finally, we have geo-referenced 12 video hotspots, each consisting of a trip back in time occurred in that place, made up of b/w amateur video clips in drool dating back to 1903.

Each video recording comes with brief captions illustrating title and year. Along with video come sound contents, similar to the "sound pills", relevant to the explored spot: it's about emotional immersive experience in history, more than philological one. Starting, and eventually stopping the hotspots required specific procedure, non interfering with user interface operations (panning and zooming), which do not require precise pointing on the screen (in a 360 degree virtual photographic tour, the user must click precisely the hotspot).

A virtual sensor has been created that feels the hotspot icon entering the middle projected area. When this happens the icon becomes highlighted and the virtual sensor change color: now the user can start the video content simply double tapping on any position of the touch area.

Double tap start/stop the video content and return to panorama exploration.

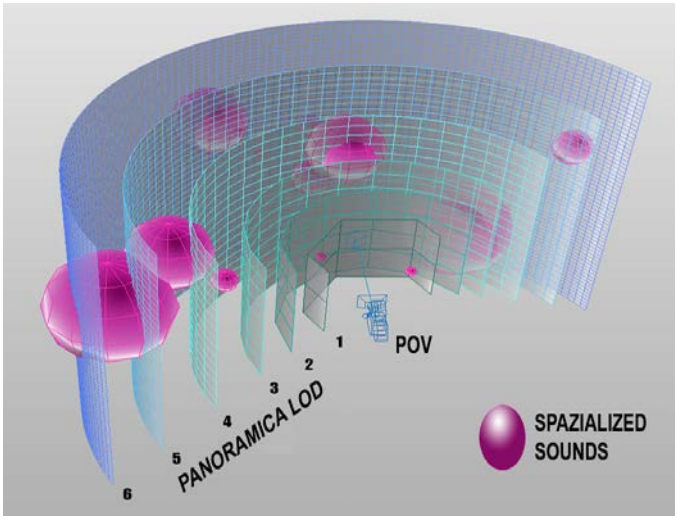

Fig. 4. The DP gigapicture six levels of detail (LOD). The spheres stand for the "sound pills" one can hear moving through the virtual space.

VIII. Usability

Unfortunately it has not yet been able to start an analytical usability review process. Hovewer, the direct observation of visitors cluster, showed the effectiveness of chosed solutions. Even the visually impaired and the blind people can to explore the “Turin city” sound space using the same interface and the same gestures of the able-bodied people. Monitoring also showed success in regards of people on wheelchair or with other disabilities: no usability issues as arisen.

IX. Stress test

Laboratory test sessions were unable to determine in full the system functionality, while useful in evaluating certain aspects of it, only usage from thousands of people should really determine complete evaluation. Accordingly, since DP inauguration (6 june 2014), a three month evaluation period has been established. This “stress test” has been helpful in resolving some minor issues regarding software bugs (only one, but there was) and to improve interface navigation. Since 15 September 2014 everything has worked perfectly.

X. Conclusions

Having in mind the The London Charter and The Principles of Seville, DP has been designed with the “user in the loop”. Standard industrial Virtual Room technologies deployment, small room space, all people access granted, were hard challenges we have been able to meet. The National Cinema Museum has received only positive feedback from public reactions. And Digital Panorama, together with other cinema archaeology fifth floor exhibitions, has been awarded and received positive media attention.

Fig. 5: The final result - outside


Fig. 6: The final result - inside

XI. Credits

Production by	Museo Nazionale del Cinema, Torino
Concept by	Donata Pesenti Campagnoni
Design by	Davide Borra
Application by	NoReal.it
Software by	Fabio Daddario
Gigafoto by	Antonino Del Popolo
Sound Design by	Vito Martinelli e Paolo Armao
Photos by	Simone Mottura - Blanco y Negro

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