

# 3D NEGATIVE SPACE BEYOND STEREOSCOPY: IMMERSION INTO THE URBAN SPACE OF VENICE

PAOLO PARMEGGIANI

Udine University, Italy

paolo.parmeggiani.ud@gmail.com

## Abstract

This paper investigates the relationship between photography, stereoviews and visual icons in Venice, and proposes an experimental video that integrates stereoscopic representations with ambient sounds. The article opens with a historical analysis of the stereoviews made in Venice, highlighting the repertoire of subjects, technology and stylistic choices adopted by the most relevant photographers of the late nineteenth century. The second section proposes an experimental project that attempts to replace the Venetian iconic touristic photographs and stereoviews. The aim is to investigate how to help the viewer focus on depth and negative spaces in a virtual space by walking him/her through different parts of the urban layout. The author discusses which of the main features are adopted to create an immersive experience through a digital combination of stereoscopic photography and binaural ambient sounds. The result indicates that it is possible to capture the essence of the 3D experience of a typical touristic sightseeing tour by applying specific digital transformations to a stereoscopic kinematic flow.

Keywords: Stereoscopic photography, binaural sound, urban space, Venice, depth information, icon, negative space.

## Introduction

The professional 3D photographer or the movie stereographer must be able to focus on the perception of space. He or she must adjust all optical parameters that contribute to the depth impression: not only in cameras, in playback devices, or framing (Confessore & River, 2012; Mendiburu, 2012; Onural, 2011), but, first, in the staging. The act of imagining where to place a subject (calculating distances according to rigid algorithms) (Smolic et al., 2011; Zilly, Müller, Eisert, & Kauff, 2010) according to other elements (additional objects or people, the buildings, the background, and the camera) forces us to concentrate on the perception of the 3D environment.

Our focus is not so much on the volumes of objects but rather on the areas among them: the place where we can choose to move to, the subject, and the camera. This emptiness, delimited by the surfaces of the objects, is referred to as "negative space". It could be considered a "public" and "potential" space since it is a clear area, and we could "potentially" access it. The same form of perception can also be triggered by a tourist walking in a city. They can shift their attention from the buildings' surfaces (facades, architectural styles, colors, or textures of materials) and volumes to the perception of the space around them. In doing so, they can therefore aesthetically appreciate the urban layout.

Is it possible to represent the immersive experience of visiting Venice using a medium that overcomes the subjects and the style popular in both the stereoviews of the late nineteenth century and in contemporary 360° digital images? How can we represent the experience of streams of continuous changes of spaces without offering a visual sequence of facades?

The methodology of this essay combines two approaches: a historical research and an experimental project. Following an analysis of the nineteenth century Venetian stereoviews, the author describes an experimental 3D video sequence that attempts to expand film language and traditional stereoscopy. The proposal hybridises 3D images and kinematic flow by applying specific digital transformations. The result is a stereoscopic sequence that represents the experience of somebody walking in Venice by focusing on the typology of urban spaces and not on touristic icons.

## Venice In The Past: From Photography To Stereoscopy

There are many sites in Venice that are relevant to its visual identity (Brunetta, 1988; Parmeggiani, 2016b). The visual representations of these buildings and monuments have become the icons of the city. As evidenced by the tourists, these images (reframed in photographs, paintings, and movies) are considered the symbolic representation of its spirit and the essence of the city (Parmeggiani, 2010).

Figure 1. A postcard that summarises the icons of Venice.  
Author's Collection

Photography has held a level of great importance for Venice and has contributed to the construction of its visual identity. In 1854 the item "Photograph" was inserted for the first time in the list of the Venetian manufacturing industries, under the category "artistic products" (Sormani Moretti, 1880). Many photographers have contributed to promoting the image of Venice between 1840 and 1870 (prior to the advent of amateur photography and its mass distribution in tourism).<sup>1</sup> Some photographers were residents; others were only visitors. Among them, there were famous travellers such as John Ruskin, who documented the Venetian architecture with a precision hitherto impossible and with a style that surpassed the invariable stereotype of the nineteenth century view (Cook & Wedderburn, 1903-12). The scholar Alexander John Ellis hoped to publish his views in the book "Italy in Daguerreotypes" (Zannier, 1992). However, among the residents of the city, the best known were Carlo Ponti (1821-1893), Carlo Naya (1816-1882), Domenico Bresolin (1813-1899) and Antonio Fortunato Perini (1830-1879).<sup>2</sup>

For his role in the history of immersive visual representations, it is vital that mention is made of Carlo Ponti, who moved to Venice after Paris. In 1855 he published his first catalogue "Ricordi di Venezia" with 160 views. This souvenir book, along with other numerous souvenir photobooks, photographic prints and stereoviews, represents the beginning of the tourist-driven production. Ponti's fame is also due to the invention

of the Aletoscopio, which was finalised as the Megaletoscopio (Zotti Minici, 2003). This instrument allowed the viewers to visualise large photographic prints through a single magnifying glass. The relief effect (often causing this optical device to be mistaken for the stereoscope), the brightness of the views, and the opportunity to observe day and night scenes made it a unique apparatus and motivated Ponti to apply for a patent in 1862.

Carlo Naya (his colleague and collaborator) opened a photo lab in the Piazza San Marco in 1857 and later in Campo San Maurizio. His favourite subjects were the architectural views, the urban landscape, famous buildings, and some selected scenes in the peripheral areas of the city. He was also interested in photographic art reproductions, especially in Padua (Roncaglia, 2009). His collaboration with Carlo Ponti in 1867 ended in a legal dispute over copyright. Furthermore, Antonio Perini (1830-1879) and the Fratelli Alinari, one of the oldest Italian photographic companies, worked with Ponti and Naya.

With the advent of photography, the image of the city was transformed. At first, the photographic representation of Venice followed the established schemes of the eighteenth-century paintings and the classical conventions (also from lithographic designs). However, it eventually changed into the "new photo paradigm" (Zannier & Costantini, 1986) that profoundly

changed the image of the city. The development of photography and the fame that some photographers acquired in Italy and abroad were connected to the transformations of the Venetian economy toward industrial, commercial, and tourism activities<sup>3</sup>. Photography influenced the field of painting (Boito, 1877), encouraged the abandonment of engravings and improved the optical devices market (Errera, 1870).

The main photographic subjects were the architectural views selected according to literary fame or following the typical itinerary of a tour guide. The purpose of this form of photography was to document the urban landscape by providing the maximum possible information on the selected buildings in one image. The production of a souvenir album was a common concern of the main photographic studios, which offered tourists a collection of approximately twenty photographs paged together and accompanied by a short caption. The sequence represented the classic tour of the city: Piazza San Marco with the basilica and the bell tower, a view of Procuratie with the Torre dell'Orologio, the Palazzo Ducale and the Libreria, the Ponte dei Sospiri, and a view from the Campanile di San Marco. Not far away is the Ponte di Rialto, a perspective of the Canal Grande, the Santa Maria della Salute, the Ca' d'Oro, the Ca Pesaro, the Vendramin Calergi, the funerary monument to Canova, and the entrance of Arsenale.

The scenes were portrayed at dawn when the streets were free from tourists. The point of view, the type of perspective, and framing were standardised. There was also a distinct stylistic

uniformity among the albums of different photographers. By 1880, the technical improvements, the progressive simplification of processes, and the reduction of costs allowed the amateurs to photograph the tour in Venice by themselves. It is a new era when "a troop of nobles saw in photography a way to highlight their social status" (Zannier & Costantini, 1986). It is the birth of a new iconography based not only on the buildings but also on ordinary urban life scenes in many hidden streets and canals (Ongania, 1891; Resini & Zerbi, 2013).

Our aim has been to examine the relationship between the representations of the city produced by traditional photography and those produced for stereoviews. Traditional photography<sup>4</sup> and stereoviews were complementary but developed a competition in the tourism image market. Initially, the stereoscopic technique was adopted only by professionals because its mastery was a complicated procedure to undertake. From the 1850's up to the 1870's, the images were made using the daguerreotype and the wet collodion techniques, which required heavy equipment, the use of the portable lab, and complex procedures not available to the general public. Later, the introduction of the dry collodion technique and the spread of small portable equipment favoured the emergence of amateur travel photography. Even the single traveller could represent the visit to the city according to his/her preferences and emotions. From an economic perspective, this was disadvantageous for professional photographers who, in order to sustain the market, developed the production of souvenir

1) Besides the tourist photography, there have been many cataloguing works of art, for example, by Carlo Naya or by Fratelli Alinari (Filippin, 2015). Since many stated that Venice was rapidly sinking into decay, the "mission of photography in Venice" is to "obtain adequate record of its art spurred on by the thought that the city, having no more place nor business in the affairs of the world, is slowly settling into a watery grave" (W., 1874 162).

2) We also mention Auguste – Rosalie Bisson (1826-1900), Giuseppe Beniamino Coen (1816-1856), Vincenzo Giacomelli (1812-1890), Giuseppe Kier (1815 ca.-?) Lorent Jakob August (1813-1884), Eugene Piot (1812-1890), Achille Quinet (1831-1900), Carl Friedrich Vogel (called Fritz, 1806-1865). (Zinelli, 1859; Zannier, 1981; Zannier, 1985; Zannier & Costantini, 1986; Vanzella, 2008; Filippin, 2015).

3) This occurred as a result of the annexation of the city to Italy in 1866.

4) The techniques used during these times were the daguerreotype, the calotype, the wet plate collodion process, the dry collodion, the salt paper, and albumen paper printing.

Figure 2. Different stereoviews portraying the Ponte dei Sospiri. Author's Collection

images at a lower cost or stereoviews that were difficult to produce (Manodori Sagredo, 2003).

Postcards, souvenir albums, and souvenir envelopes containing the photographs were the best-selling brands. The albums were composed of a collection of stereoviews (12 to 64 typographic reproductions) of the most famous places. The photographers who mostly employed this technique were Carlo Naya, Carlo Ponti Antonio Perini, Tommaso Filippi, Fratelli

Alinari, Giorgio Sommers and Edmond Behles, Giorgio Conrad, Eugenio Chauffourier, Pietro Bertoja, Sebastiano Bressanin, Giuseppe Bettini, and Francesco Bonaldi (Manodori Sagredo, 2003; Zotti Minici, 2003).

The standardisation of the subject consisted in a series of places, buildings, and viewpoints that became the icons of Venice: this phenomenon has lasted to the present day and has involved equally traditional photography and stereoscopy.

Figure 3. An albumen print, a hand-coloured night view, a *carte de visite*, and stereoviews; these different formats and photographic processes share the same bird's-eye view (the Campanile of San Marco). The photographic company of Carlo Ponti and Carlo Naya printed and sold all these images. Author's Collection

The uniformity in the choice of places, the style, and the process made it possible to reduce costs for a mass market that did not require more creative representations. Since the stereoscopic picture is composed of two individual photographs, it was common practice to sell the stereo pair and a single image of the same shot. This habit did not favour the distinction of composition and perspective between 2D and 3D, and it should be emphasised that the visual similarity has played a crucial role in the weak evolution of stereoscopy's language

and style. Most of the stereoscopic views of Venice share a similar viewpoint to the 2D photographs. In the second part of the nineteenth century, the same framing was used not only for various stereo series but also for different photographic formats.

Tourists bought regular and stereoscopic photographs at a much lower price than would be required for an original work. These pictures also had a lower cost than those produced by

the tourist: "stereoviews, printed on paper and then mounted on cardboard by Carlo Naya cost 50 cents, while a stereoscopic slide on glass plate costs 3 francs" (Manodori Sagredo, 2003 11).

The crisis of the production of stereoscopy, which took place between 1860 and 1880 in Europe and in the United States, was not perceived in Venice thanks to the demand for tourist pictures. The tourist flow supported its production, and the 1880's witnessed a revival of the success of stereoscopic photography, even at the amateur level. The handmade production of these images was significant up to the end of the First World War, when it began to decline.

This technological and socioeconomic account explains some of the reasons why professional photographers did not develop a specific stereoscopic style and did not choose new subjects for 3D images. The choice of the same landmarks and the same perspectives of the urban landscape were of greater importance than experimenting with innovative ways to frame the spaces of Venice.

### Contemporary Representations of Venice

Venice, together with other Grand Tour destinations, is an emblematic example of production, consumption, and reproduction of photographic icons (Manodori Sagredo, 2012; Parmeggiani, 2010; Parmeggiani, 2016b).

Today we can find those subjects framed in millions of 2D shots and 3D photographs. The canonization<sup>5</sup> of the landmarks for the touristic mass market, combined with the cultural power of the icons, generated a series of stereotyped images that developed into the reference standards for professional photographers and amateur tourists<sup>6</sup>. More than a hundred and fifty years later, those icons, as synecdoche, still bind a single element (a monument, a building or an architectural detail) to the identity of the entire urban landscape. These visual symbols are spread in the mediasphere and are relevant elements of the international visual mass culture. As cultural souvenirs, they not only represent the essence of the city; they also have become the key drivers of the city's mass tourism because visitors look for those sites and photograph them, or use them as a background for selfies.

Sight has undoubtedly been the most used sense in our history to represent the landscape, the cities, the buildings and the places around us. The contemporary digital framework offers novel possibilities to visually represent the urban landscape with aerial photography and satellite imagery: platforms like

5) The term "canonization" refers to a general agreement of their high quality: both dissemination and provenance of photographs contribute to the canonization of buildings (Christenson, 2017).

6) According to some scholars (Ethington & Schwartz, 2006; Debarbieux, 1995; Monnet, 2006), the main characteristics of icons are that they gained fame, are simple and easy to remember, reduce the visual complexity of the city, often recall the past and are variants related to the same cliché.

Google Earth allow interactive and virtual photographic explorations (Schwarzer, 2017). Beyond the bird's eye, we can also achieve a ground level perspective (Street View launched by Google in 2007) with 360° photographs that provide panoramic street views or views of specific spots<sup>7</sup>. We can virtually move along the streets, looking straight ahead, rotating the angle of vision or eventually zooming in on details: these visual technologies allow us not only to hold very accurate information of the city but also a certain degree of immersion.

However, sight is not the only choice<sup>8</sup>. Distinguished scholars noted the power of the other senses in evoking a place. There is also a growing interest in nonvisual forms of representation in contemporary urban studies (and in disciplines like sociology, anthropology, and human geography) (Aiello, 2016). These types of records can convey the impression of immersion in a specific place using other senses. The growing popularity of concepts like "smellscapes" (Henshaw, 2013; McLean, 2017) or "soundscapes" (Raimbault & Dubois, 2005; Lavandier & De-fréville, 2006; Ge, Lu, Morotomi, & Hokao, 2009) demonstrate that sensory stimuli such as odours or sounds could identify and characterise specific parts of a city.

The anthropologist Sarah Pink highlights how the sensory experience of the city is connected to movement:

Given the difficulty of considering visual practices, images or experiences in isolation from the other senses and narratives, consideration of the relation between the visual and the haptic experiences of walking remains a vitally important question. (...) the visual as always embedded in the multisensoriality and movement that is integral to the practice and experience of everyday life: what Patterson (Paterson, 2009) terms the interplay of the visceral and visual. (Pink, Hubbard, O'Neill, & Radley, 2010, p. 2)

Beyond the images, filming can invite the viewers to engage "via movement forward through an environment rather than merely by watching/observing from a distance" (Pink et al., 2010, p. 3).

### Capturing The Essence Of Urban Space Through 3D-Negative-Spaces

Our experiment to represent the essence of a city is named 3D-negative-spaces. This proposal combines many

7) The power of digital computation can combine enormous amounts of information. Photographs, GPS data, and map information from various sources (from photo-sharing websites like Instagram, Panoramio, Pinterest, Facebook, and Flickr to public archives) also allow quantitative and qualitative studies (for example) about urban landmarks and city icons (García-Palomares, Gutiérrez, & Mínguez, 2015; Kádár & Gede, 2013; Zhou, Liu, Oliva, & Torralba, 2014).

8) According to the common opinion, the other four traditionally recognised human senses are hearing, taste, smell and touch. Therefore, we also have other sensory modalities that make us feel pain, vibration, balance, temperature or kinesthetic sensations. To set definite borders between these distinct stimuli is difficult. Many scholars in the cognitive neuroscience literature claim a cross-modal interaction among senses, for example, between vision and the sense of touch (Spence, 2002; Berthoz & Petit, 2008). This type of light synesthesia and these correspondences and associations could help to explain the viewer's consistent sensation of his/her bodily presence in the scene when he/she looks at stereoviews (Parmeggiani, 2016a).

characteristics about the typology of ordinary urban spaces, the kinematic sequence of stereoviews, the audio-visual integration with soundscapes, and the focus on negative spaces.

Our first choice was to shoot ordinary places instead of famous buildings. Since our hypothesis was that the Venetian essence does not consist only of the architectural masterpieces but also in the varied sequences of the public spaces, we avoided taking pictures of the best-known spots, the city's icons. We did not want to focus on single buildings, monuments, churches or outstanding views but to discover Venetian details in the urban landscape.

The number and the variety of traditional ways of naming urban places are an index of the complex typology of these sites. Venetians do not use the usual Italian words such as *Strada* (street) or *Canale* (channel). A series of toponymical terms evoke the ancient culture of the Serenissima: *imbarcadero*, *fondamenta*, *corte*, *piscine*, *calle*, *calletta*, *campo*, *campiello*, *sotoportego*, *ruga*, *ramo*, *rio interrato*, *salizada* and many others. Even an initial and provisional analysis of the types and qualities of these public spaces could reveal many differences between a *Salizzata* (street laid with cobblestones), a *Riva* (walking bank of stones along a *Rio*, in front of a broad expanse of water), a *Sotoportego* (a low porch that passes between houses), a *Calletta* (a narrow-bricked street, even 53 centimeters wide) or a *Ponte* (there are 340 bridges of stone or metal over channels of different sizes).

**Caption:**

**Video "IMMERSION INTO THE URBAN SPACE OF VENICE"**  
(Available at [goo.gl/Ps6dMb](http://goo.gl/Ps6dMb))

Our second choice was to adopt the form of video instead of a sequence of still images to be viewed individually. The aim was to focus the viewer's attention on the volumes' variations that occur along touristic itineraries. Walking implies, of course, the movement of the body in different urban spaces. This performance and sensorial experience are marked by crossing the thresholds of separate sites. Our bodies feel the long distance or short proximity, the presence or absence and various degrees of prominence of the channel or the sea, of walls, of arches, of bridges. The sequence of different urban spaces characterises the Venetian sightseeing tour like a city's DNA. How could we represent the pedestrian sightseeing practice when the multitude of different details obscures the single building and highlights the historical environment as a whole?

We decided to photograph a series of sites that compose an ideal pathway within the historic city centre<sup>9</sup>: it represents the typical scenic itinerary that tourists take in over a one-day visit to Venice. The path starts from the Venetian railway station, continues with sailing on a *Vaporetto*, crosses Piazza San Marco, goes through the historic centre streets, sails in a gondola along the channels, continues into the area of Rialto Bridge and ends at the station. All the spots are close to each other.

9) The stereoscopic photographs have been geotagged by GPS (Global Positioning System) to record their precise position in a map of the area and to help the synchronisation of landscapes with soundscapes.

Such modulations in the shapes of the public spaces, which change according to our walking, are very similar to those depicted by stereographers and 3D movie directors in the depth scripts and depth charts (Mendiburu, 2009; Smolic et al., 2011).

Figure 4 A depth script from the 3D movie *Coraline* (Gardner 2011)

These graphics describe the 3D variations of different scenes according to the movie timeline and the development of the narrative. There must be a variation for the spectator, but this should not be excessive (depth continuity) so as not to create visual discomfort.

Our third choice was to privilege the negative space instead of the roundness of the buildings' volumes. According to the Gestalt theory, the viewer can focus on the foreground or the background. In other words, it is possible to become aware of the solid volumes of the buildings or the shape of the "empty" area around them. We can gain an impression of the air between the surfaces. In this negative space, we could (to a certain extent) move and (sometimes) immerse our body.

|

In our experimental project, to ensure the viewer focuses on the void rather than on the images, the photographic stereoviews were transformed into outlined stereoviews. The rationale for subtracting information (cancelling visual data from the figures to focus on the volume of the space) was inspired by a technique adopted in Sir Charles Wheatstone's first experiment in 1833. Wheatstone explained that he employed outline figures to leave no doubt that the relief effect was not due to shading or colouring (two monocular depth cues) but only due to stereopsis.

He wrote, "I have employed only outline figures, for had either shading or colouring been introduced it might be supposed that the effect was wholly or in part due to these circumstances, whereas by leaving them out of consideration no room is left to doubt that the entire effect of relief is owing to the simultaneous perception of the two monocular projections, one on each retina" (Wheatstone, 1838, p. 376).

In our experiment, we erased visual information about colours and shades to address the viewer's attention not to the surfaces (like the icons of Venice do) but to the volume's edges. The buildings lose part of their roundness, and the viewers are less distracted by their fronts. We think the resulting image is more abstract and can better symbolize a category of urban spaces.

Figure 5. Charles Wheatstone's outline figures (Wheatstone, 1838)

The conversion of the original colour stereoviews into black and white images and the stylisation of the shapes' edges were created by applying a series of digital filters. We also removed other visual information, such as the shading (which

Figure 6. Anaglyphs of two stereoviews without and with the digital filter. contributes to defining the volume of objects), part of the textures, and the details of the surfaces<sup>10</sup>. Every image simplifies the 3D depth information<sup>11</sup>.

Our fourth key choice was to synchronise the image with the soundscapes. The sounds and noises were made by people walking or talking, by animals barking or squawking or by church bells ringing. These sounds produced different reverbs and the stereo delays according to the distance and the substance of the surfaces. The qualities of the public areas are related not only to their extent but also to the materials they are surrounded by. The marble, the bricks, the water, the wood,

10) The filter (Pencil Sketch) uses a special algorithm with specific values. It combines Gaussian blur, high pass filtering, desaturation among others. The output is similar to a "pencil sketch" effect, which could be interpreted as a creative drawing. Actually, this process is a precise algorithm, rather than an artistic transformation. Similar visual transformations occur, for example, in astronomical image processing: here the original images are enhanced by stacking, the use of filters, and change of the dynamic range.

11) Unlike what is carried out in most naturalistic representations, we keep the relevant visual information about the volumes of the objects by removing some features.

the boats, the people and even the pigeons mark the areas with their images and noises. These elements at the borders of the void spaces not only refract the lights and the sounds but also communicate the differences between different urban environments (Gandy & Nilsen, 2014).

For these reasons, we decided to integrate the stereoscopic views with the soundscapes (the actual environmental sounds of the landmarks). We used two sensitive microphones to record daytime sounds while simultaneously shooting the photographs<sup>12</sup>. To take advantage of the immersive qualities of sound to form spatial images within the headspace of the listener, we set up the audio recordings according to the binaural technique. This method is used in an attempt to preserve the ability to perceive the location of the sounds we hear, thanks to the spacing of our ears and the acoustic properties of our heads. We used a Jecklin disk (Eargle, 2012) to preserve the natural 3D perception of sound: it is a sound-absorbing disk placed between the microphones, which simulates the effect of the head and creates an acoustic *shadow*. This feature makes binaural different from the stereophonic recording but requires one to wear headphones to perceive the effect upon playback.

## Conclusion

The result of our research is a stereoscopic video composed

by the stereoviews synchronised with sound bits<sup>13</sup>. The reader can watch the full version or download it from the following URL <https://youtu.be/-KPGH224Gew> (anaglyph format) or <https://youtu.be/ieviqCjQnmY> (the video in side-by-side format has a better quality if seen with an appropriate stereoscopic player). The best hardware to enjoy the depth and sense of immersion is virtual reality equipment with headphones, but the viewer can also use anaglyph glasses, watch the video on a PC display<sup>14</sup> and listen from the speakers. In this case, the quality of both the stereoscopic video and binaural sound will be lower because of the poorer separation of the left and right audio and video channels.

We believe the essence of Venice, which makes its urban landscape memorable and unique, lies not only in the richness of works of art or in the facades of specific buildings. Walking into the city centre or moving in a *vaporetto* or gondola means going through high and low, large and narrow, dry and wet, long and short places. Venice offers its visitors a continuous variation in the dimensions, shapes and sensory quality of public spaces. This distinguishes it from other cities (especially where history has not left such noticeable traces) that are more homogeneous. For these reasons, the integrated visual and auditory perception of the *negative space* is a key component of the average aesthetic appreciation, an essential part of the immersive urban experience and a recognisable element of typical touristic walking sightseeing tours.

12) During postproduction, the stereophonic binaural ambient sounds were synchronised with the corresponding stereoviews.

13) This research is in progress: further studies should be performed, for example, about different technical choices or the reception by the viewers.

14) There are many video players that convert the side-by-side format into an anaglyph movie. Unfortunately, because of the fixed interaxial distance between the two lenses of the stereoscopic camera, some frames will show an excessive depth budget or a window violation. These factors could cause visual discomfort on some displays.

This experimental video could represent the sequence and the variations of spaces as tourists perceive them; the reduction of colours, textures and visual details help the viewer to focus on the sensation of the space, instead of on the surfaces of the buildings. Other distinctive features of the Venetian experience are the lack of traffic noise and the presence of sounds such as water in canals, seagulls or conversations heard from afar thanks to the silent environment. The stereophonic binaural technique highlights the reverbs and reflections of these sound stimuli, adding a lot of depth information to the stereoscopic images. With this experimental project, we did not mean to propose a popular alternative to contemporary touristic documentaries and photographs. Compared with existing audiovisual media, it requires proper equipment to be seen, it is not based on easily recognisable icons and the viewer needs longer time to appreciate the effect. We believe that focusing on how to improve the stereoscopic representations could benefit the new immersive media (like 360° video, virtual reality, and other forms). The choice of subjects, their language and the sensorial effects they achieve will evolve only through a series of experimental tries.

## REFERENCES

Aiello, L. M. (2016). *The Sensorial Map of the City*. Paper presented at the Proceedings of the 25th International Conference Companion on World Wide Web.

Berthoz, A., & Petit, J. (2008). *The physiology and phenomenology of action*. Oxford: Oxford University Press.

Boito, C. (1877). *Scultura e pittura d'oggi*. Torino: F.lli Bocca.

Brunetta, G. P. (1988). Per una carta del navigar visionario. In C. A. Zotti Minici (Ed.), *Il mondo nuovo. Le meraviglie della visione dal '700 alla nascita del cinema*, (pp. 13-29). Milano: Mazzotta.

Christenson, M. (2017). Critical Dimensions in Architectural Photography: Contributions to Architectural Knowledge. *Architecture\_MPS*, 11(2), 1-19.

Confessore, G., & River, J. (2012). *3D stereoscopico. Guida professionale per cinema, Tv, new media*. Milano: Fag.

Cook, E. T., & Wedderburn, A. (Eds.). (1903-12). *The Library Edition of the Works of John Ruskin*. London: Allen. Debarbieux, B. (1995). Le lieu le territoire et trois figures de rhétorique. *L'Espace géographique*, 2, 97-112.

Eargle, J. M. (2012). *Handbook of recording engineering*. Berlin: Springer Science & Business Media.

Errera, A. (1870). *Storia e statistica delle industrie venete e accenni al loro avvenire*. Venezia: Stab. Priv. Di Giuseppe Antonelli.

Ethington, P., & Schwartz, V. (2006). Introduction: An Atlas of the Urban Icons Project. *Urban History*, 33(1), 14.

Filippin, S. (2015). La riproduzione fotografica delle opere d'arte a Venezia tra la metà del sec. XIX e il 1920 ca. Materiali per una ricostruzione storica. (Tesi di dottorato), Università di Padova. Retrieved from <http://paduaresearch.cab.unipd.it/7505/>

Gandy, M., & Nilsen, B. (2014). *The acoustic city*. Berlin: Jovis.

García-Palomares, J. C., Gutiérrez, J., & Mínguez, C. (2015). Identification of tourist hot spots based on social networks: A comparative analysis of European metropolises using photo-sharing services and GIS. *Applied Geography*, 63, 408-417.

Gardner, B. (2011). *Perception and The Art of 3D Storytelling*. 2017, from <https://library.creativecow.net>

Ge, J., Lu, J., Morotomi, K., & Hokao, K. (2009). Developing soundscapegraphy for the notation of urban soundscape: its concept, method, analysis and application. *Acta Acustica united with Acustica*, 95(1), 65-75.

Henshaw, V. (2013). *Urban smellscape: Understanding and designing city smell environments*. London: Routledge.

Kádár, B., & Gede, M. (2013). Where do tourists go? Visualizing and analysing the spatial distribution of geotagged photography. *Cartographica: The International Journal for Geographic Information and Geovisualization*, 48(2), 78-88.

Lavandier, C., & Defréville, B. (2006). The contribution of sound source characteristics in the assessment of urban soundscapes. *Acta Acustica united with Acustica*, 92(6), 912-921.

Manodori Sagredo, A. (2003). *Venezia e la fotografia stereoscopica*. Mariano del Friuli: Edizioni della Laguna.

Manodori Sagredo, A. (2012). *Le icone fotografiche del grand voyage tra fine Ottocento e primo Novecento*. Bologna: Bononia University Press.

McLean, K. (2017). Smellmap: Amsterdam—Olfactory Art and Smell Visualization. *Leonardo*, 50(1), 92-93. doi: 10.1162/LEON\_a\_01225

Mendiburu, B. (2009). *3D movie making : stereoscopic digital cinema from script to screen*. Amsterdam; Boston: Focal Press/Elsevier.

Mendiburu, B. (2012). *3D TV and 3D cinema: tools and processes for creative stereoscopy*. Taylor & Francis US.

Monnet, J. (2006). The Geopolitics of Visibility: Urban Icons in Contemporary Mexico City. *Urban History*, 33(1).

Ongania, F. (1891). *Calli e canali in Venezia*. Venezia: Ferdinando Ongania.

Onural, L. (2011). *3D video technologies an overview of research trends*. Bellingham, Washington: SPIE.

Parmeggiani, P. (2010). Integrating multiple research methods: A visual sociology approach to Venice. In P. Burns, J.-A. Lester & L. Biddings (Eds.), *Tourism and Visual Culture, Volume 2: Methods and Cases* (Vol. 2, pp. 94-110). Wallingford: CABI.

Parmeggiani, P. (2016a). Between the Point of View and the Point of Being: the Space of the Stereoscopic tours. *International Journal of Film and Media Arts*, 1(2), 14.

Parmeggiani, P. (2016b). Guardare Venezia: la città come dispositivo visuale. *California Italian Studies*, 6(1), 32.

Paterson, M. (2009). Haptic geographies: ethnography, haptic knowledges and sensuous dispositions. *Progress in Human Geography*, 33(6), 766-788.

Pink, S., Hubbard, P., O'Neill, M., & Radley, A. (2010). Walking across disciplines: from ethnography to arts practice. *Visual Studies*, 25(1), 1-7.

Raimbault, M., & Dubois, D. (2005). Urban soundscapes: Experiences and knowledge. *Cities*, 22(5), 339-350.

Resini, D., & Zerbi, M. (Eds.). (2013). *Venezia tra Ottocento e Novecento nelle fotografie di Tomaso Filippi*. Roma: Palombi Editori.

Roncaglia, E. (2009). *Carlo Naya fotografo veneziano: il ruolo della fotografia del XIX secolo nella rappresentazione del paesaggio urbano*. (Dottorato in Storia e critica dei beni artistici, musicali e dello spettacolo), Università di Padova, Padova. Retrieved from <http://paduaresearch.cab.unipd.it/1845/>

Schwarzer, M. (2017). Computation and the Impact of New Technologies on the Photography of Architecture and Urbanism. *Architecture\_MPS*, 11(4), 1-16.

Smolic, A., Poulakos, S., Heinzle, S., Greisen, P., Lang, M., Hornung, A., . . . Schnyder, L. (2011). *Disparity-aware stereo 3d production tools*. Paper presented at the Conference for Visual Media Production (CVMP).

Sormani Moretti, L. (1880). *La Provincia di Venezia, monografia statistica – economica – amministrativa raccolta e coordinata dal conte Luigi Sormani Moretti regio prefetto*. Venezia: Antonelli.

Spence, C. (2002). Multisensory attention and tactile information-processing. *Behavioural Brain Research*, 135(1), 57-64.

Vanzella, G. (2008). *Venezia agli albori della fotografia: 1850-1870*. Treviso: Associazione Trevigiana Antiquari.

W., A. J. (1874). Photography in Venice. *The British Journal of Photography*, xxi(726), 161-162.

Wheatstone, C. (1838). Contributions to the Physiology of Vision. Part the First. On Some Remarkable, and Hitherto Unobserved, Phenomena of Binocular Vision. *Philosophical Transactions of the Royal Society of London*, 128, 371-394.

Zannier, I. (1981). *Venice, the Naya collection*. Venice: O. Bohm.

Zannier, I. (1985). *Venezia. Immagini del XIX secolo dagli Archivi Alinari*. Firenze: Alinari.

Zannier, I. (1992). *Sublime fotografia. Il Veneto*. Venezia: Corbo e Fiore.

Zannier, I., & Costantini, P. (1986). *Venezia nella fotografia dell'Ottocento*. Venezia: Arsenale-Bohm.

Zhou, B., Liu, L., Oliva, A., & Torralba, A. (2014). Recognizing City Identity via Attribute Analysis of Geo-tagged Images. In D. Fleet, T. Pajdla, B. Schiele & T. Tuytelaars (Eds.), *Computer Vision – ECCV 2014: 13th European Conference, Zurich, Switzerland, September 6-12, 2014, Proceedings, Part III* (pp. 519-534). Cham: Springer International Publishing.

Zilly, F., Müller, M., Eisert, P., & Kauff, P. (2010). *The stereoscopic analyzer—An image-based assistance tool for stereo shooting and 3D production*. Paper presented at the Image Processing (ICIP), 2010 17th IEEE International Conference on.

Zinelli, F. M. (1859). *Osservazioni attorno alla dagherrotipia, alla fotografia ed alla stereoscopia*. Venezia: Giuseppe Grimaldo.

Zotti Minici, C. A. (2003). *Il fascino discreto della stereoscopia: Venezia e altre suggestive immagini in 3D*. Padova: Grafiche Turato.