VR SCENOGRAPHY: IMAGE AND SOUND

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ABSTRACT: Contemporary art faces various challenges to the role it has traditionally performed. Artists are increasingly dependent on digital broadcasting, or digital elements used in real projects such as concerts, theatrical performances. It also requires computer graphic artists to spend a great deal of time developing virtual scenography in the context of relational objects (actors). The interaction of new technologies with art, however, gives us the opportunity to create new artistic and perceptual forms of art.

1. INTRODUCTION

CCII (Cultural and Creative Industries and Institutions) backup artists and performers with their creativity [1,2]. This has usually been done by organizing concerts, performances, shows and art displays at specialized cultural centres/ concert halls/ theatres and art galleries with necessary technical background [3,4].

The alternative approach is to use digital media and internet to introduce audience/spectators to some, at first glance, hard to access places. It is usually done with the help of streaming technologies and high-end devices [5,6]. However, currently available technologies like smartphones create new public demands. People prefer individual access to information. Their evaluation of received information is more often based rather on emotional than rational issues. There is a tension between people who create a content as an emotional/educational experience and those who see it as a pure leisure. The whole way in which art is viewed is undergoing a complex change. Streamed digital media and Virtual Reality seem to be the technological answer to the challenges. Engaging spectators on individual basis, digital media can broaden his/her perception of art without the blur of stereotypes.

2. VR AND 360 DEGREE VISUALIZATION (THE BACKGROUND)

The main goal of visualisation is to bring understanding of data. The task is to present complex information in the most comprehensive and legible manner. Considering 3D art the visualisation process is mostly focused on the understanding of spatial relations and on the recognition of particular style and form. The most natural way to convey this information is to build a three dimensional model or evoke the sense of presence in a specific place with the 360 degree panoramic images [7,8,9]. Virtual visualization might be the next stage in developing of visualization systems and 3-dimensional computer graphics is currently the market standard even on mobile devices. The adequate definition says virtual reality is applying information technology to create interactive 3-dimensional world effect, in which every object has presence property. It is possible to create single objects, virtual setups/scenes or even whole virtual cities [10]. 3D graphics is widely used in the field of architecture and history, notably in the virtual reconstructions of buildings targeted at wide public [11].

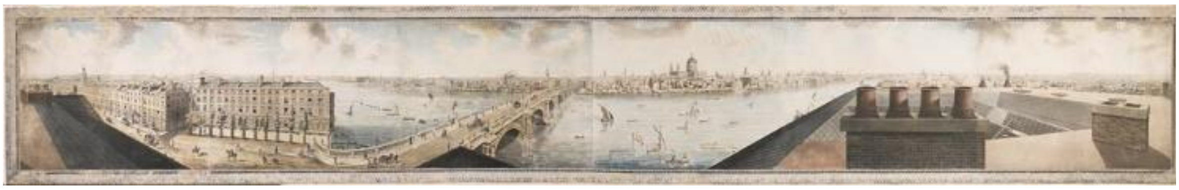

Figure 1*: The Panorama of London by Robert Barker, 1792*

Figure 2*: A partial picture of The Raclawice Panorama*

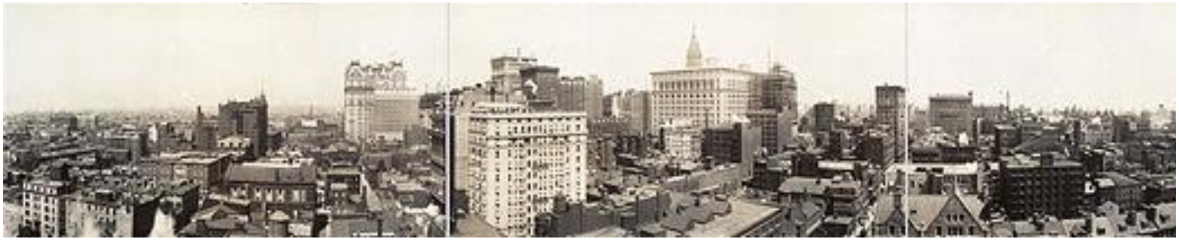

Figure 3*: An example of first 360^o panoramic pictures*

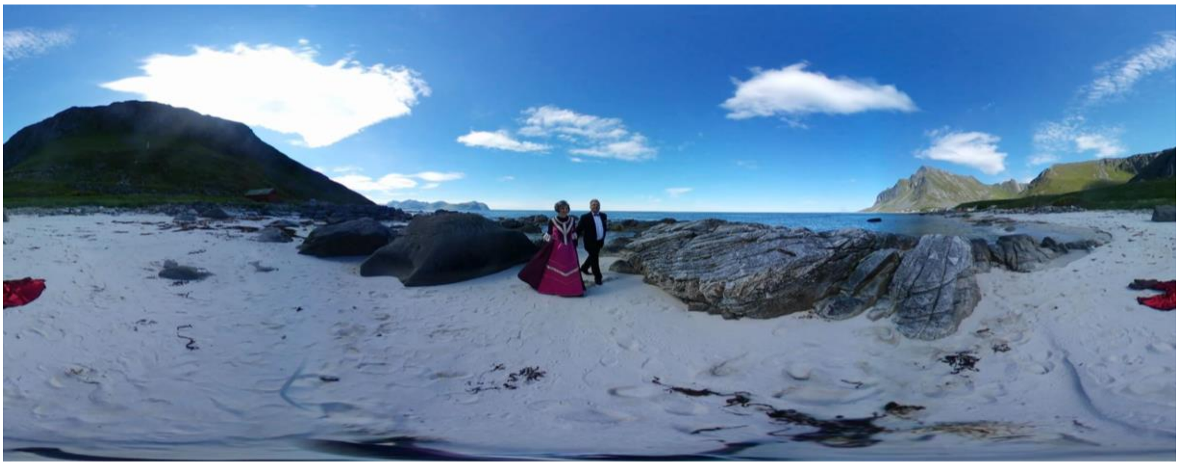

Figure 4: *360^0 panorama, part of the LOFOTS project made by K. Orleański*

Unfortunately most of the visualizations depict static models with none or only simplified atmospheric effects (weather, seasons) and very often with limited or no environmental context (pedestrians-humanoids and foliage). Digital storytelling techniques have been successfully adapted to education of history and architecture. The idea presented in the paper is based on that area of science discussing the use of commonly available technologies to perform ‘environmental’ visualization for digital scenography.

The first 360^o visualisation attempts were oil paintings, to mention the works of Robert Barker depicting Victorian London and (Fig 1.) and the work titled *Battle of Raclawice.* This painting (Fig. 2)was created in 1893-1894 by a team of painters led by Jan Styka and Wojciech Kossak [12]. Now, it is exhibited in Wrocław under the name of *The Racławice Panorama [2]*.

The technological development enabled replacement of manual painting with 360^o photography. Panoramic cylindrical pictures are usually created by “stitching” together few pictures into significantly bigger image (Fig. 3). It is also possible to construct spherical panoramas covering horizontally (360^o) as well as vertically (180^o). It is also possible to construct spherical panoramas covering horizontally (360^o) as well as vertically (180^o). It relies on taking several pictures of the scene and their subsequent combination, with the use of a special computer software or an app on cameras and smartphones (Figure 4).

The 360^o spherical video is a natural successor of the static imaging. It is a type of a movie that is realised with the use of a multi-lens spherical camera [13]. This technology facilitates registering reality in the 360^o viewing sphere, so the filmed material is recognised by the viewer horizontally and vertically (fully immersive video). The spherical movie can be viewed on a regular computer screen. The direction in which we look can be controlled with a mouse or a simple control panel to pick the most interesting fragments of the reality. Thanks to that, spherical film projection creates an illusion of participation in events presented in the film.

Such an video device was constructed in the Laboratory of the Institute of Electronics and Telecommunications in the Norwegian University of Science and Technology (NTNU). It uses 6 GoPro Hero4 cameras which are placed on the specially designed tripod. (Figures 5a, 5b).

Alongside with the prevalence of high speed data processing computers, it has become easier to give panoramas new dimension which uses interactivity (elements of virtual reality) [14].

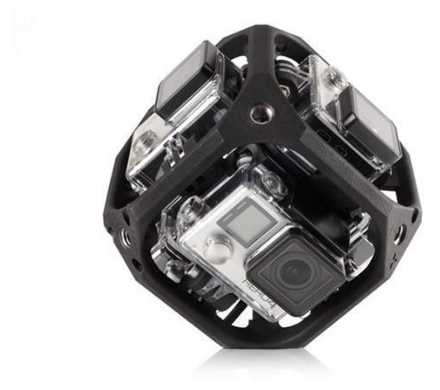

Figure 5a*: GoPro 360^o camera for creating spherical videos*

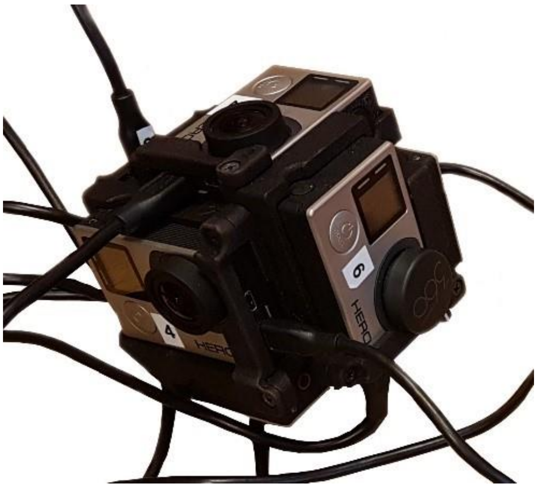

Figure 5b*: A spherical camera engineered at the NTNU*

Virtual reality (VR) - an image of artificial reality created by means of Information Technology. It is based on multimedia creation of computer generated objects, space and events in 3D which enables interaction with the computer simulated environment using various input devices. It may represent elements of both, the real and fictional world.

VR settles on displaying only computer generated objects which do not interact with real world objects. It is often mistaken for augmented reality.

Augmented / extended reality (AR) is a system that links the real world with the one generated by computers. It is a standard procedure to use an image produced by a room. Thanks to this, virtual objects are possible to be presented to the real world.

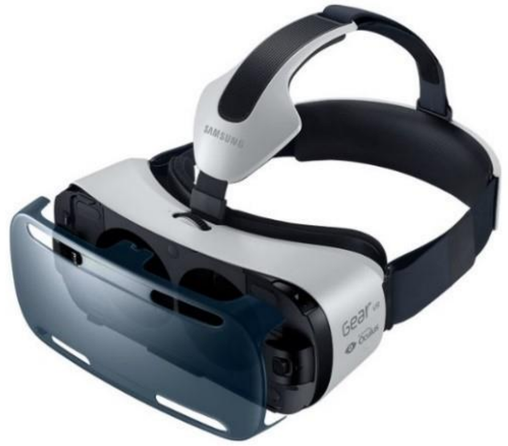

***Figure 6**: Samsung Oculus Glasses for smartphones*

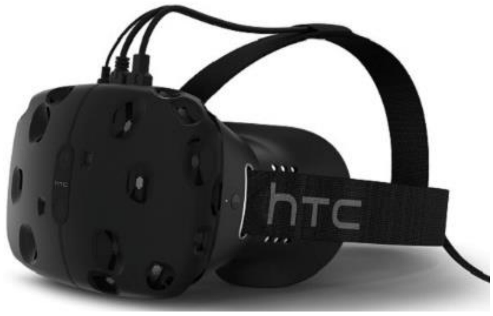

***Figure 7**: HTC glasses with two screens*

camera which is then layered with real-time generated 3D graphics.

Basic features of augmented reality are: combining the real world with virtual reality, enabling the user to move freely in three dimensions and real-time interactivity.

In order to display information in both, virtual and augmented reality, it is possible to use various technologies, e.g. smartphone applications connected with special glasses (Figures 6, 7). Augmented reality user does not lose its orientation in the environment thanks to the cameras and the location sensors system (triangulation, GPS). It recognizes a location of objects in the real world and then superposes virtual information.

HTC system discover system where technique is based just on two sensors scanning the movement of a person walking around a virtual The authors of this publication were focused on Norwegian landscapes and photographed them using 360^{o} technique. These images could be viewed from the middle of a virtual room created by means of computer graphics. Integration of virtual information with the reality will allow to create stage designs as a reconstruction of architecture or historical places. It creates a possibility of displaying additional information about an object and guarantees more realistic experiences in contrast to pictures, films or 3D images displayed on a screen. In case of museums or theatres, augmented reality may allow for sharing their collections when there is no space in exhibition halls or on the stage. Recording the concerts or theatre plays in real interiors and landscapes using the 360^{o} technique then becomes necessary. Combining these sequences with computer graphics creating a virtual interior which imitates, e.g. a recital hall, is challenging for artists, photographers and computer graphics designers.

3. LESSONS LEARNT

Creating virtual scenography that seamlessly blend with the natural context is not an easy task. The virtual set, as the element of artistic performance, should convey desired mood and conform to the director's vision and expectations. Moreover, the film and game industries offer new user engaging experiences with better photorealistic (3D) graphics, surrounding sound and complex interaction. This induces demand for better quality of non-commercial visualizations for wider (game-educated) audience. We ask several questions, whether it is possible to efficiently put real-life artists within the virtual setup. What limitations need to be considered both for digital artists and for real-life performers? Would it be practical to producers and engaging enough to the spectators to mix artistic performance with digital content?

Some hints to answer these questions have been collected by the authors of this paper through their experience with several projects devoted to digital scenography (Fig. 10). Different approaches were considered, exploiting a range of technological solutions that challenged production of the real-plus-virtual performance. The main goal was to provide the best technical and artistic quality, that could be achieved with available means. The technologies used in the projects included: stereoscopic images (both static and dynamic), 360 degree stills and video depicting natural landscapes and scenery, computer generated sets, advanced projection systems (polarised glasses, DLP and background projection), HMDs untracked and with user tracking.

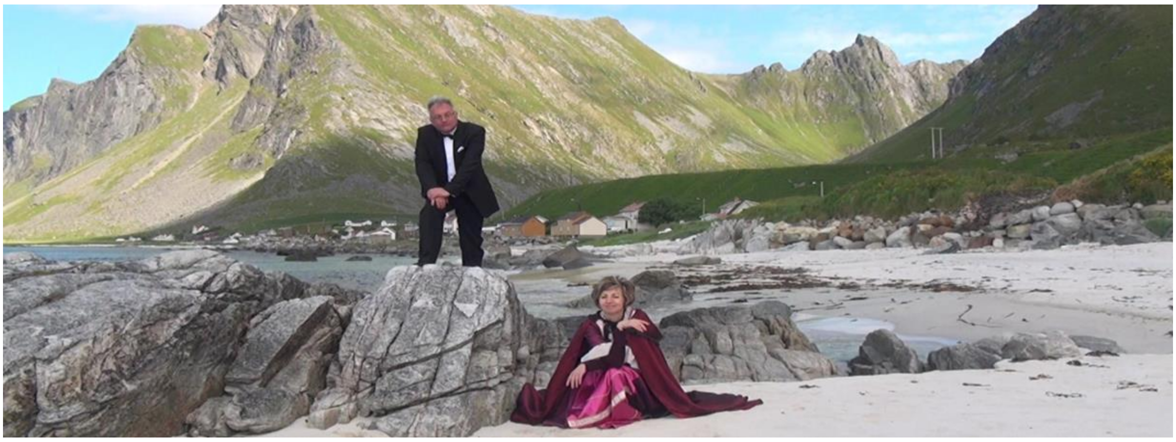

***Figure 10**: Cut scene from the 360 degree performance*

Each of the technologies has its own features both giving some freedom of artistic expression and setting up some technical limitations. From our experience, while preparing virtual scenography, we should consider/solve the following issues:

Scale. It is extremely important to preserve accurate proportions to make the virtual background fit the artist performing on the stage. As mentioned before, real and virtual should seamlessly blend into one consistent experience to the spectator. Sizes of the stage, the backing screen and the auditory determine the technical limitations of the setup. The background projection behind the scene gives more flexibility, and some elevated platform may help to put the artist in the accurate spot depicted on the screen. Generally it is easier to adjust computer generated images that captured form the nature.

Image depth. It is controlled by the parallax, the difference between the left and the right eye that determines the distance we perceive [15]. Generally with the bigger screen it is possible to obtain greater image depth. When the parallax is equal to zero we see objects "on the screen", so the distance between the virtual and real image are the same. Negative parallax makes the objects "pop up" from the screen, the effect that can give eye strain when observed for longer time. Positive parallax put objects behind the screen and seems to be more comfortable for the viewer. We have to remember that perception of the stereoscopic space is relative and the sharpest image is guaranteed only with the zero parallax.

Lights and shading. The performing artist should be lit with lights corresponding with the virtual scenery. Again, it is much easier to blend computer generate 'theatrical' set with artificial lighting, When the background projection is not used, the only solution to avoid the artist casting shadow on the screen is to lit him with led lights set placed close to her/him. The background projection is more flexible and also gives unique opportunity to put the artist behind the screen and play with her/his shadow.

Location. As it was mentioned before, sizes of the stage and the auditory determine the technical limitations of the setup. If the stereoscopic imaging is considered, the spectators need to be located in limited field aligned to the optical axis of the projector. The side views result in deformed perception of 3D space and inconsistent 'placement' of the performing artist in the virtual scenography. Field of view is also limited by the DLP technology, the sensors built in the active spectacles have rather narrow range, even comparing to the stereoscopic projector capabilities. Generally, we can say that the 3D glasses determine the possible virtual space.

Head positioning. We must remember that we deal with the illusion of 3D space that is created in the head of the spectator and the real life artist should 'fit' to the overall experience. The actual effect of stereopsis is limited by human perception. I.e. the best perception is achieved only when the 3D eyeglasses are parallel top the screen, the head should be kept in straight position. Looking sideways it is very likely we will lose the 3D illusion. Since the nose partially obscures our vision, with only one eye we cannot determine the distance and the stereoscopic effect is lost. When we tilt our head, and the images are not adjusted to the head position, the brain tries to fix the position of our eyes to compensate the distortion. It works to some extent, but the we 'switch' to perception of two separate images overlapping. The moment before 'switching' is highly uncomfortable to the viewer.

Stereoscopic blindness. Not everybody is able to perceive depth in stereoscopic images. It is assumed that few percent of population cannot combine two separated images into one three dimensional space. Moreover eye accommodation that degrades with the human age can also limit perception of 3D, thus making children the best target audience for such technology. We must also remember that even eye fatigue can ruin the 3D experience.

The most promising solution is to above mentioned problems it to use VR HMD customized to the individual user physiology. HMD with advanced sets of sensors, follows the movement and orientation of the spectator, there are no limitations induced by the screen size, as the image fills the whole view. The question is, how to put the real performer into the completely immersive VR, then?

3. CONCLUSION

The digital scenography presents several challenges in the field of digital culture and art. The narrative approach positions visualization of the art as an emotional experience that follows the ambition of visual realism and understanding of the artist's performance. It is possible to greatly enrich the usefulness of digital media representations, provided that some attention is put to quality of the information delivered in the virtual media. Already existing techniques of visualisation, such as 360^{o}, VR and AR, determine a necessity of creating missing artistic contents which, combined with the new technology, will create a new, synergic quality [16].

4. ACKNOWLEDGMENTS

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