Maniello, D. (2016), Michelangelo's David: An augmented reality application on real scale, using the technique of video mapping. In: Homem, P.M. (ed.) *Lights On… Cultural Heritage and Museums!.* Porto: LabCR | FLUP, pp.123-138

MICHELANGELO'S DAVID: AN AUGMENTED REALITY APPLICATION ON REAL SCALE, USING THE TECHNIQUE OF VIDEO MAPPING

Donato Maniello[1]

ABSTRACT The present work is the result of a research started with Studio gloWArp (www.glowarp.com) in partnership with Academy of fine arts in Naples. To achieve and prove such result, in this project it was used a particular technique of augmented reality called video mapping with the aim of reevaluating the replica in scale of the world famous "David" by Michelangelo, sculpture present in the same building. The installation (projected the 27th February 2015), entitled "Michelangelo's David", is the demonstration of how new technologies can play a fine role for the enhancement of cultural heritage of a nation it got the patronage of UNESCO that has entitled the 2015, International Year of Light (IYL) and of the technologies based on light. Thanks to the art of video mapping the rediscovery of this sculpture has achieved a great result, success based not only on the reevaluation of the work of art but also because such performance touched the soul of the audience leaving them in an ecstatic state. Thanks to the live event, a large number of the audience for the first time came to know the existence of this replica work, present in the building of the Academy, of which they totally ignored the presence. Another aim of the project is that of showing the artistic potentiality of the mix among analogical and digital media and how video mapping could be also considered as an extension of the painting. A reevaluation of cultural heritage through video mapping that is perfect for the standards expected by the law in matter of cultural properties in Italy. The action of reevaluation is not to be considered as an attempt to substitute the peculiar value of the work itself. Part of this project will be show in a website.

KEYWORDS Augmented reality; Cultural heritage; Video mapping; Michelangelo's David

[1] Academy of Fine Arts, Naples / Studio gloWArp, info@glowarp.com

Maniello, D. (2016), Michelangelo's David: An augmented reality application on real scale, using the technique of video mapping. In: Homem, P.M. (ed.) *Lights On… Cultural Heritage and Museums!.* Porto: LabCR | FLUP, pp.123-138

1. Introduction

"[...] We are the digital artisans. We celebrate the heroic energy of our work and of our imagination to give shape to the virtual world. Hackering, coding, mixing and designing, we build our interconnected future thanks to our commitment and to our inventive [...]". The quote here above is a fundamental passage to best describe the basic approach of the present research work but also, the quote addresses us towards the aim of the project in description, putting in constant conversation digital and analogical fields in which the handmade work is in tight connection with the technological process. The quote is from "The Digital Artisans Manifesto" written in 1997 by Richard Barbook and Pit Schultz. The manifesto is an independence declaration of the digital artisans who evoke through electronic manufacture the experience of the manual creative labour. Technological innovation, if well interpreted and with the right poetic, can assume more interesting shapes and dimensions. Thanks to technology it becomes possible to totally revolutionize the way we understand and project whatever kind of cultural experience and create innovative contests for the fruition of it. Nowadays, in fact, it is possible to notice how the majority of museums, of exhibition spaces, of architectonic realizations and restorations, of the studies of ancient construction industries and urbanization make a good use of the potentiality of augmented reality. *The definition of the concept of "cultural heritage"* spurred a broad debate with the enforcement on May 1st 2004 of the Code of the Cultural Heritage (entirely transposed in the Italian legislation by the legislative decree 42/2004 as amended). To this regard we would like to focus on one specific aspect, that is the legislator's precise intention of strengthening the idea of identity in cultural heritage, so much that the traditional definition of cultural

heritage intended as "things … testifying the values of civilization" was modified as follows: "the founding and representative element of national identity". This definition expresses the intent to include the vast category of "immaterial things" and broadens the framework in which the measures of protection and safeguard of cultural heritage are set. Specifically, *Art 6 of the Code of the Cultural and Landscape Heritage states the fundamental principles for the development of cultural heritage, defined as follows:* "[…] the exercise of the functions and in the regulation of the activities aimed at promoting knowledge of the cultural heritage and at ensuring the best conditions for the utilization and public enjoyment of the same heritage, with the aim to promote the develop culture […]". This function sets the framework for the present study. Doing so, the intrinsic cultural value of a due subject of study becomes evaluated thanks to the use of advanced new technologies.

This research continues the one started by the Studio gloWArp (is a multimedia studio that focuses on applied new technologies in the sphere of art and is specialized in applications in museum contexts for the promotion of cultural heritage) in technology implementation on cultural heritage. One example is the use made of this technology in previous work and some being as the application of augmented reality utilizing the A.R.I.M. system (Augmented Reality In the Museum) (FIG. 1) devised in 2013 by Studio gloWArp in the reproduction of axisymmetric vases of Greco-Roman era for multimedia totem (Maniello, 2015) (FIG. 2)*;* on Block NXLVI Parthenon Nord Frieze (Cirafici et al., 2015) (FIG. 3); on the scale reproduction of the Dinos, coming from the hypogeum Varrese in Canosa di Puglia, Italy (FIG. 4).

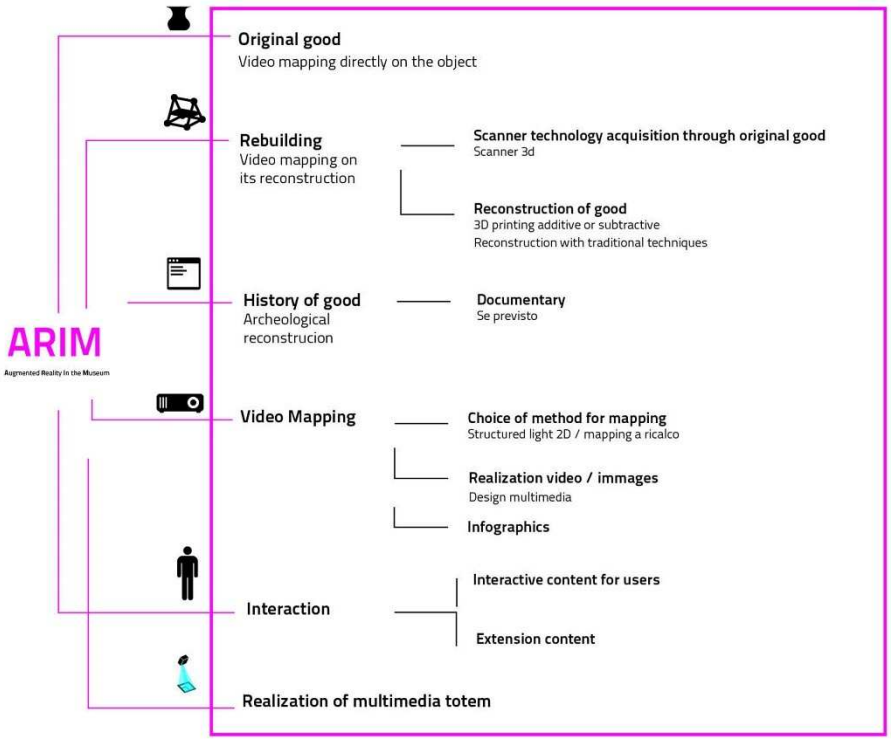

FIG. 1 - A.R.I.M. system_2013.

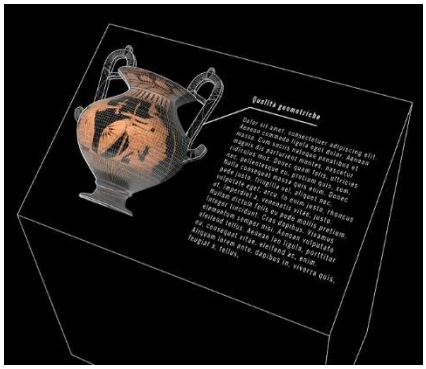

FIG. 2 - Proposal for a multimedia totem_2013.

FIG. 3 - Picture of documentary screened_2015.

FIG. 4 - Video mapping on Dinos from hypogeum Varrese_2015_Canosa di Puglia (Italy).

In Italy, there are few examples, of other author, of such operation to consider and are firstly, the one which took place in Rome for the rediscovery of the "Altare della Pace" (FIG. 5; Ara Pacis, 2014, Alberto Pizzoli) for the remembrance of the Emperor Augustus.

FIG. 5 - Ara Pacis_2014_Rome.

Thanks to the projection technique of video mapping, the marble facades of the monument were rendered in colours to recreate its original polychromy to give a realistic effect without risking to damage its structure. The choice of each single coloration of the "Ara Pacis" was operated on the base of precise laboratory analysis compared to roman time paintings, especially from Pompeii, and further chromatic researches on ancient architectures and sculptures. Those analyses were carried out during many years by a team of researchers. With a similar approach and aim, in the south of Italy, it was established an event named GLOWFestival (Maniello, 2014) (www.glowfestival.it), that reaches its third edition in 2015. The festival was conceived and created to reevaluate the cultural heritage of Ostuni, thanks to this particular technique of augmented reality that is the video mapping. The founders of the festival (Studio glowarp.com) saw in the video mapping the right qualities to be implemented in reevaluating various

places of the city of Ostuni such as the inside of: "Chiostro di San Francesco" (FIG. 6; video mapping performance, Palazzo di Città, Ostuni, I[st] Edition of GLOWFestival 2013, Studio gloWArp); the Saint Vito Church, which is also the location of the "Museo della Civiltà preclassiche della Murgia Meridionale" (FIG. 7; video mapping performance, Ostuni, II[nd] Edizione of GLOWFestival 2014, Studio gloWArp), and "L'Arco Scoppa" (FIG. 8; III[rd] Edition of GLOWFestival 2015, Studio gloWArp). The festival was based on various performances selected via open call, modality that gave to many artists the possibilities to participate with their own projects and visions. This was a fundamental experience that gave the chance to investigate a different kind of fruition in the cultural-artistic field. Augmented reality lets add more information to a subject consenting to discover and to see a work of art with new sights. The aim is also that of reaching a larger audience tickling their curiosity and fascination, establishing a

FIG. 6 - GLOWFestival, I edition_2013_Ostuni, Italy.

FIG. 7 - GLOWFestival, II edition_2014_Ostuni, Italy.

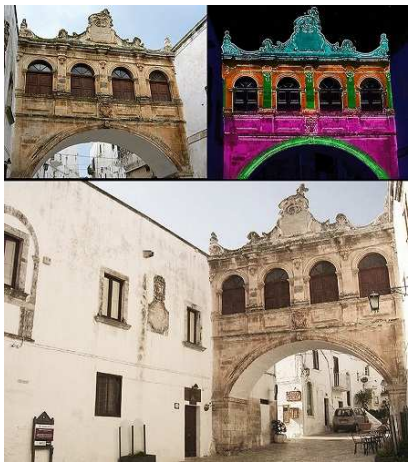

FIG. 8 - GLOWFestival, III edition_2015_Ostuni, Italy.

bridge between the people and the cultural heritage of a city, composing a new narrative based on local history and traditions using contemporary innovative techniques.

This type of project involves the interaction among different arts, where sculptures, painting, architecture and technologies meet to create a unique interactive experience for the audience to enjoy. The spectacular nature of the fruition through the technique of video mapping is in the situation where the public participate directly with their own bodies in the interaction without any use of other devices. Nowadays, one of the disadvantages present in the majority of the systems based on augmented reality is that they imply the use of devices designed to appreciate its potentialities. In cases like this, the audience should have a knowledge about the functionality of the technology to really appreciate its innovation and acquire information. This type of situation requires a longer time and a practice not always available which makes it more difficult for everyone to enjoy it.

Cultural heritage is the proof that allows us to glimpse and to explore with our imagination what it was and why it was built. To be in front of a work of art gives us the opportunity of flying on the wings of fantasy and totally immersing ourselves in a kind of mystery, a discovery that can be enriched thanks to innovative tools but also thanks to the use of a classic method that always works fine and succeed in its aim; the research based on hard-copy manuals. Augmented reality increases our sensory perception but too often is just limited to the momentary spectacular effect offered by a digital object. The risk is that augmented reality becomes only an ephemeral technological experience that could substitute the real value of a work of art. This is why the project "Michelagelo's David" is focused on a sculptural reproduction that not everybody knows, a reevaluation that

is not available in any manual of history of art and that calls out for imagination. This type of fruition of cultural heritage, where the analogical gets mixed with the digital, gives the possibility to explore a work of art under different point of views, highlighting the true importance of the sculpture itself.

2. The acquisition technique

The first step to produce a video mapping project is the mapping, which is essential to match the virtual model with the real one. The mapping is obtained starting with the marking of the structure we wish to work on and it is achieved using various tools such as a computer, a reflex photo camera, a video projector and a wide-angle. Those tools allow us to collect all the information we need to rebuild the sculpture and the structure around it. Because of the difficulty in the acquisition of the scene, two techniques were used: 2D scansion (structured light) and a photographic mapping (Maniello, 2014). With structured light mapping once the position and distance of the video projector are set, this method allows the creation of an image that appears as if it were being "seen" by the video projector (FIG. 9).

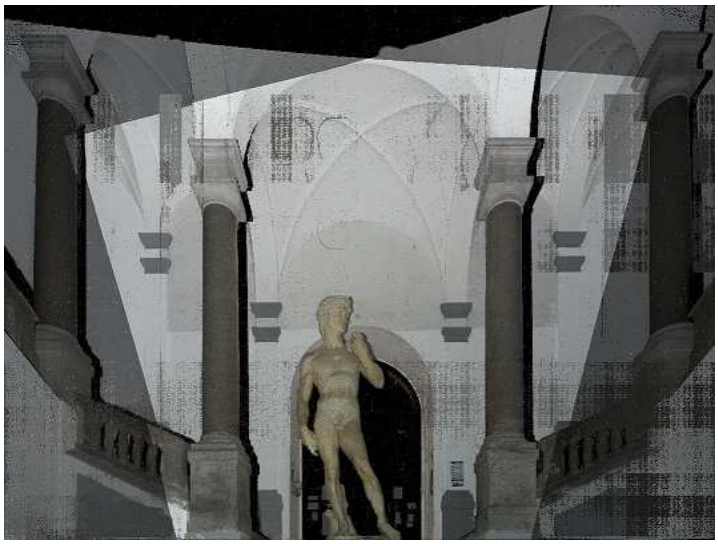

FIG. 9 - Image that appears as if it were being seen by the video projector_2013_Academy of Fine Arts_Naples

This is the first image from which the mapping process starts. A file generated this way can encounter two kinds of problems: whites off range and the loss of levels of detail (a fundamental aspect of indoor mapping and on a small scale), and noise due to the generation of the file with structured light. The levels of detail, if significant, can be recovered using the other two mapping methods while an attempt to clear noise effect can be made with Photoshop. In fact, the surface being white and the projector's light frontal but the source low, levels of detail are lost that only split lighting can provide. For this reason, the following mapping methods are useful. With trace mapping, once the image to be traced has been obtained, this technique allows real-time tracing of the detail lost with the previous method with the use of Photoshop. Once the image has been corrected with the previous techniques, photographic mapping allows us to use a photograph shot in the appropriate scale and then modified (with warping techniques) to make it perfectly coincide with the mapping file previously created. This procedure provides a perfect texturizing, where all the details rest perfectly on the tridimensional original model, the colours enhanced by the model's whiteness. With the above-mentioned methods and the real-time correction of imperfections here and there we have obtained the definition of the final image (FIG. 10), a stage followed by the creation of the layer masks with Illustrator (FIG. 11).

FIG. 10 - Final image_2013_Studio GLOWArp.

FIG. 11 - Layer masks with Illustrator_2013_ Studio GLOWArp.

The creation of these masks was carried out in conjunction with the archaeological study of the exhibit, as this provided useful means for understanding the shapes and details and their spatial configuration and depth. This is a very delicate step because the layer masks represent a synthesis of the shapes from which all the files necessary for the creation of the documentary are derived.

In fact, once we have obtained the image, which was taken from a near point of the projector, this was adjusted according to the real proportions of the subject and the rest of the chromatic aberration were eliminated with the use of Adobe Photoshop.

The masking layers are the materials needed to create 2D and 3D animations and will be useful during the warping phase of the creation process.

The warping is used to create the illusionistic effect and it is based on three geometrical transformations (FIG. 12). Those are the homothety, the homography and the anamorphosis. Those are needed to match the virtual model with the real one. Homothety is a geometrical transformation of the space and of the plane, that either expands or compresses the objects, leaving unaltered the corners and so the structure. Homography is the relation between the points of two spaces in which at each point of Space A correspond one and only one point of Space B. Anamorphosis is when an image is distorted and it is made visible only from one perspective point of view, creating the optical illusion that is the fundamental and spectacular characteristic of video mapping. In summary, the procedure was adopted: the real model, to scan with structured light and finally the projection with video mapping technique. (FIG. 13).

FIG. 12 – Warping phase _2015_ Studio GLOWArp.

FIG. 13 - Real model. Scan with structured light. Video mapping_2015_ Studio GLOWArp.

3. The creation of performance

The accurate study of the architecture is a fundamental step for the making of a performance because it allows the constructing of the contents based on the design of the planes on which we will go to work on, aiming to a conversation among the surrounding and the video and not vice versa. Once the reconstruction of the masking layers was completed and the acquisition of the painted boards was finished, the next step was the importing of the files to Adobe After Effects and Cinema 4D. This software allows the creation of the majority of the animation effects. An important factor for the success of a video mapping performance is not just the visual contents but also its soundtrack. In "Michelangelo's David" the fundamental characteristic is the fusion between two moments: the transition from winter to

spring. The music chosen for this project was "The winter and the spring" of Italian compositor Antonio Vivaldi. Some sound effects were used to put emphasis on some particular parts of the video performance. The video and sound editing was done with Adobe Premier (FIG. 14), which resulted in the creation of a final piece of the length of 5 minutes. The performance was presented to the public on the evening of the 27th February 2015 (FIG. 15) at the Academy of Fine Arts of the city of Naples after obtaining the authorization for the performance by the directorate upon presentation of a formal request.

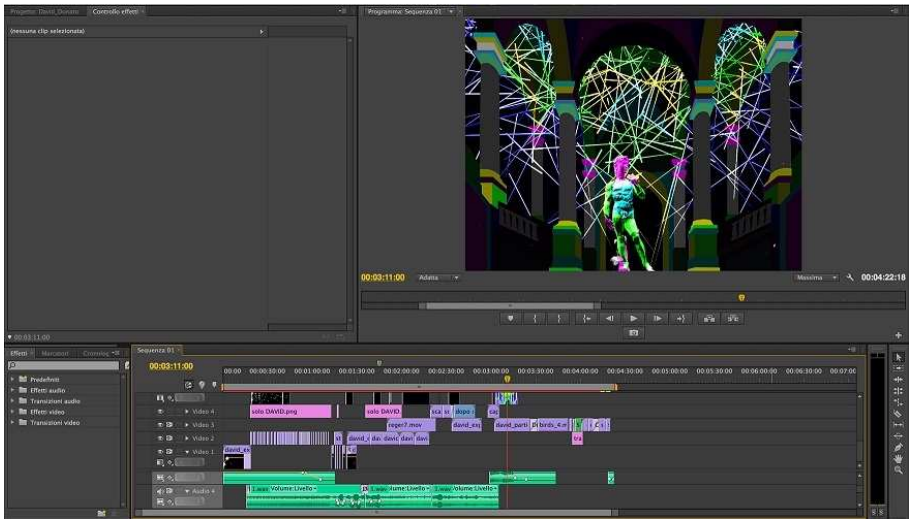

FIG. 14 – Adobe Premier project_2015_ Studio GLOWArp.

FIG. 15 – Frame performance_2015_ Academy of Fine Arts.

4. Communication and website

A multimedia event was created. To keep track of the flux of visits on the website Google Analytics code was used to monitor the access. Social networks were employed to spread the communication online with a positive feedback from the target audience.

This art project was finalized towards the creation of a multimedia event. To achieve so, the project was curated in its total, from the video mapping performance production to the communication plan. Flyers and leaflets were designed and printed. The graphic design included a QR Code (FIG. 16). A web site was designed (www.3david.it), which was built making sure that it would be available and fully working on computers but also on mobile devices such as smart-phones, tablets (FIG. 17).

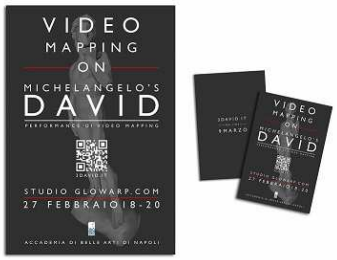

FIG. 16 – Graphic project, flyer ad invitation card_2015_ Naples.

FIG. 17 – Website sample view on mobile devices_2015_ Naples.

The graphic design was kept simple and essential in its lines and contents to allows its users an easy and intuitive utilization, information was put together to be available to be enjoyed either analogically or digitally. The choice of the colours is based on the idea of having a chiaroscuro contrast so, a dark background and light text perfectly aligned in the page to make it easy to read and consult thanks also to a very clear font (Gill Sans Regular). The rendering of the reproduction of the David in 3D was placed centrally, reducing the polygonal effect to give the subject a more contemporary design style and fading its colour composition and making it just visible in a way that the whole figure could not disturb the viewing of the readers. On

the web site is available the video recording of the live performance, photos of the event and a pdf with the dissertation. To publicize the event a press kit was put together and sent to a large number of magazines and newspapers, two weeks in advance and also it was available for download from the website. Also, social networks as Facebook and Twitter were employed to spread the communication online with a positive feedback from the target audience. To keep track of the flux of visits on the website it was used Google Analytics code, which was placed in the index and helped the monitoring of the numerous access to the website. This was useful to have data available about the work done for the communication giving positive numbers as result of a communication well planned and professionally carried on. It was essential the value of feedback obtained by the online monitoring because the high virality and virtual expectation was then matched by presence of people at the night of the event. This was a great result which went well beyond the expectation considering that those mentioned above were the only communication channels used without receiving any further support. The web site is also well indexed on Google using the keywords: video mapping napoli and video mapping david.

5. Projection

The project was carried out with the XGA projection resolution (1024x768 px), 4:3 format, luminosity of 4000 AL and wide angle. This resulted in a perfect illumination of the subject and the surrounding space once the area was totally dark. For the warping phase, Mad Mapper software was used. This software allows to edit the video in real time. The final result is visible at this link: https://vimeo.com/122750458.

6. Conclusions

Among the many aspects of this project, the use of light as artistic medium is the one of major importance. In fact, this is the year entitled as UNESCO International Year of Light and of the technologies based on light (IYL). Video mapping is based on light and it is the art form that promotes sustainable developments through culture. Another aim of the project "Art Remixed on Michelangelo's David" is that of showing the artistic potentiality of the mix among analogical and digital media and how video mapping could be also considered as an extension of the painting. An artistic language and a new creative method that allows a total immersion and an augmentation of the sensory perception through the use of digital media in an analogical field. The projection of paintings lets us experience the brush strokes and the colours tonalities under a new light towards a total different perception of the unique works of the artists of the past century. The video mapping puts a new pictorial skin on the hero of Renaissance totally transforming its white marble surface. The spectators experience the subject as never seen before, a very original vision of it. A reevaluation of cultural heritage through video mapping that is perfect for the standards expected by the law in matter of cultural properties in Italy. In fact, the regulations for Cultural Heritage and the Territory state, in the article number 6, the fundamental principles for the activity of reevaluation of the national cultural property, defying such activity as *"[…] all of those activities directly involved in the promotion of knowledge of the cultural heritage and assuring the best conditions for the public utilization and fruition of such patrimony with the aim of promoting the progression of national culture […]".* This aim was fully achieved during the performance "Michelangelo's David", because thanks to the live event a large number of the audience for

the first time came to know the existence of this replica work present in the building of the Academy of Fine Arts of Napoli of which they totally ignored the presence. Thanks to the art of video mapping the rediscovery of this sculpture has achieved a great result, success based not only on the reevaluation of the work of art but also because such performance touched the soul of the audience leaving them in an ecstatic state.

References

Cirafici, A.; Maniello, D.; Amoretti, V. (2015), Block NXLVI_Parthenon_Nord Frieze_In Augmented Reality the magnificent adventure of a "fragment". *Scires* [online]. 5(2). Available from: http://caspur-ciberpublishing.it/index.php/scires-it/issue/archive [Accessed 25th November 2015].

Maniello, D. (2014), Augmented reality in public space: basic techinque for video mapping. Brienza: Le Penseur.

Maniello, D. (2015), The video mapping projection indoor for promotion of cultural heritage: the glowfestival case**.** *Screencity Journal* [online]. 6. Available from: http://screencitylab.net/publications/ [Accessed 25th November 2015].

Maniello, D. (2015), Realtà geometrica e aumentata in ambito museale: tecniche base di video mapping su vasi assialsimmetrici con proiezione mono video proiettore. *In: Idee per la rappresentazione, Aversa, 2014. Napoli.*