CASE STUDY

Leonardo da Vinci's Last Supper:
Enhanced Uses and New Digital Pathways

by Francesco Gavioli, Eleonora Ligas

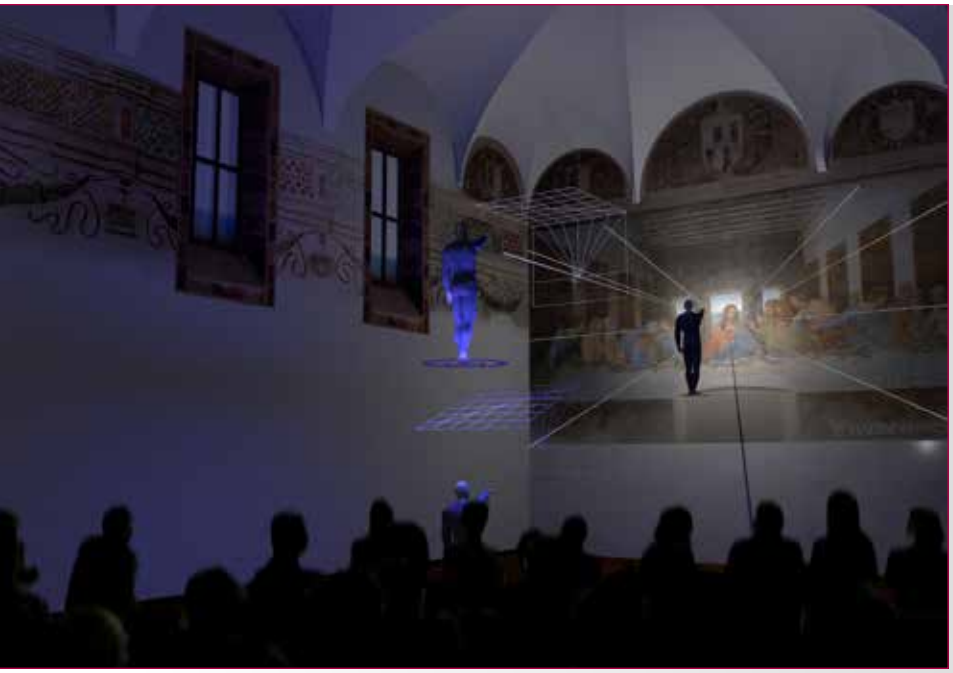

Fig.1 - Last Supper Interactive project by Franz Fischnaller in the Deep Space 8K at the Ars Electronica Center in Linz.

In recent years, the growing field of digital enhancement of the cultural heritage has seen more and more projects dedicated to the works and writings of Leonardo da Vinci. Digital Humanities[1] and Digital Storytelling[2] projects have been conceived and developed to enhance Leonardo's masterpieces.

This article offers a survey of some examples of digital enhancement of Leonardo da Vinci's Last Supper where Haltadefinizione's ultra-high definition digital image was used. Starting from the digital storytelling project Last Supper Interactive, we will examine several instances of uses of these images. We will also focus on the ultra-high definition digital acquisition process itself.

LSI - LAST SUPPER INTERACTIVE

One of the most fascinating recent digital storytelling projects based on the Last Supper is the immersive installation LSI - Last Supper Interactive, on exhibit in the Deep Space of the Ars Electronica Center in Linz. LSI is an 8K-3D augmented reality project that aims to offer a deep understanding of the Last Supper and the historical and architectural context in which this mural painting was created. The centerpiece of the project is the ultra-high resolution photograph of Leonardo da Vinci's Last Supper, a 21-billion pixel image composed of 1042 individual frames, the result of the digitization that Haltadefinizione performed in 2010.

Inside LSI, Franz Fischnaller has built the Alberti's Theorem Virtual Tool (ATVT), an interactive learning device inspired by the perspective rules of Leon Battista Alberti. It shows how Leonardo applied linear perspective in the Last Supper. With this tool, you can observe the painting from different elevations and points of view, even from within the pictorial space. It provides a unique view of the details and positions of the apostles at the table.

The LSI application brings its visitors right inside the Last Supper for a full view of its narrative and symbolism, as well as an understanding of Leonardo's use of linear perspective.
LSI was created in 2019 as a collaboration between Haltadefinizione, Professor Franz Fischnaller and Cineca (Bologna). The project was updated this year at Linz with the participation of the Laboratory of Computer Vision and Reverse Engineering of the Polytechnic University of Milan, which added its 3D digitization of the monastic complex of Santa Maria delle Grazie, including the basilica, the cloister and the refectory.

Fig. 2 - Digitization project of Leonardo's Last Supper.

THE GIGAPIXEL DIGITIZATION OF THE LAST SUPPER

At the center of this immersive experience is the ultra-high definition 'gigapixel' image of the Last Supper by Leonardo da Vinci. In 2007 and 2010, Haltadefinizione conducted two ultra-high resolution digital photographic sessions, in collaboration with the Lombardy Regional Museum Directorate and the Museum of the Last Supper (*Museo del Cenacolo Vinciano*). During photography, the Italian State Center for Restoration in Rome tested Haltadefinizione's equipment and certified that it is in full compliance with the current rules for the protection of the artistic heritage.
The digital image of the Last Supper was for many years the largest one ever made.
Gigapixel images allow you to explore the smallest details of this masterpiece, and are an extraordinary tool for conservators. An ultra-high resolution image serves as a benchmark for planning any conservation efforts. Restorers and specialists were able to compare the two gigapixel images taken three years apart to monitor the evolution of the conservation status of a masterpiece notoriously subject to degradation due to Leonardo's unusual technique[3].
Historians of Leonardo have described his mixed technique of tempera and dry oil on plaster. It promised a chromatic intensity and a brilliance of the pigments that could not have been possible in fresco. However, only a few years after its completion, the technique turned out to be vulnerable and began to show the first signs of decay.

Fig. 3 - Leonardo Da Vinci, Last Supper, 1494 - 1498, Dry wall-painting, Basilica di Santa Maria delle Grazie - Milan
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INTERACTIVE STORYTELLING AND A CLOSER LOOK AT DETAILS

From the point of view of valorization and discovering new enhanced uses, the goal of these digitization campaigns was to make the ultra-high definition image available online for free, to enable scholars and art lovers to admire the Last Supper from closer then they could ever see with the naked eye.

Gigapixel images are very large files that consist of billions of pixels. To manage them online, Haltadefinizione uses a Digital Asset Management (DAM) software application called Coosmo. It is designed specifically for ultra-high definition digital files and other heavy digital objects like 3D models. Haltadefinizione developed it with the support of Memooria, a leading company in the supply of software and hardware for Digital Humanities.

Using the DAM, specially designed for the world of cultural heritage, several collaborative projects have been made possible between Haltadefinizione and DRM Lombardia - the Lombardy Regional Museum Directorate. The software has allowed the Last Supper to be made available on the website of the Last Supper Museum (*Museo del Cenacolo Vinciano*) with descriptions that follow the user's focus all the down to the individual brush strokes.

The digital platform is full of potential for a deeper user experience, with multimedia storytelling that can have customizable paths. The goal is to broaden people's knowledge of the works through this new tool that allows you to create real virtual guided tours for a deeper understanding of digitized masterpieces.

With this in mind, the online viewing tool lets the user create interactive narratives based on the work. For example, at Easter in 2021, Haltadefinizione and the Lombardy Regional Museums Directorate designed a virtual tour that invited art lovers and scholars to discover details on the Last Supper table setting that are almost invisible to the naked eye[4].

To show its use as a teaching tool, there was also a detailed study of the iconological meanings of the objects seen in the table setting for the Last Supper, which made it not only interesting to the general public but also useful to specialists.

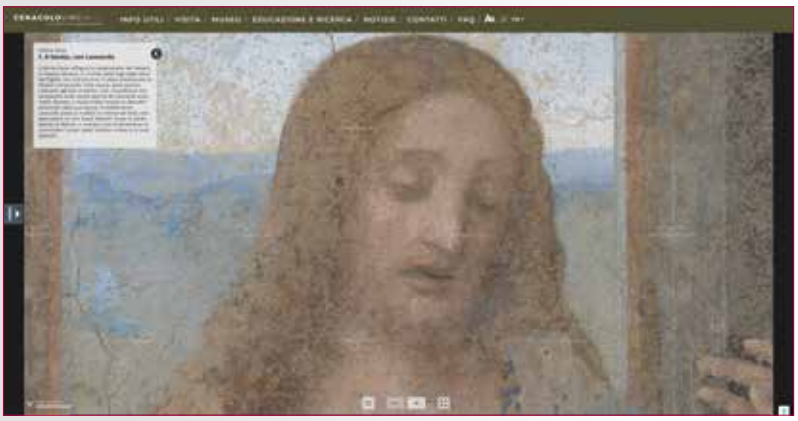

Fig. 4 - Virtual guided tour available on the website of the Cenacolo Vinciano, made possible through Coosmo, Digital Asset Management (DAM) software for Cultural Heritage developed by Haltadefinizione.

CONCLUSION

In conclusion, these projects show how new technologies are revolutionizing our ways of preserving and valuing our cultural heritage. The potential offered by digital models has brought about new ways to make use of great works like this one. It has also led to an increase in visitor traffic to the actual site in Milan. These projects for the digital enhancement of the Last Supper were pioneering examples that have led to a long series of renovations at one of the most visited UNESCO sites in Italy. We hope that, along with with the project now underway of redesigning a more sustainable museum[5], the Lombardy Regional Museums Directorate will continue to invest in the digital enhancement of this extraordinary site. In this way, they will carry on the important work of preservation and dissemination of the rich cultural heritage of the Last Supper around the world.

HALTADEFINIZIONE SRL AND HALTADEFINIZIONE GMBH

Haltadefinizione is a technology company specialized in the protection and enhancement of the historical and artistic heritage through the realization of digitization campaigns in ultra-high definition, 3D and multispectral surveys.

Thanks to its long experience in the field of scanning large-format works (frescoes, paintings, maps, statues, tapestries, etc.), the company plans every digital acquisition in accordance with

the physical conditions and the location of the work, ensuring excellent results in all conditions of photography, without ever needing to move the works. Haltadefinizione also applied aerophotogrammetric survey techniques with drones to digitize entire buildings and monuments of historical and artistic importance.

In addition to the digital acquisition of works of art in ultra-high definition, the

Research and Development department also deals with the engineering of innovative machines for gigapixel and 3D photography and for the production of 3D replicas.

Thanks to the development of software for the management and use of ultra-high definition images, the company offers digital storage and preservation services for cultural heritage through Coosmo, its Digital Asset Management service. Specifically designed for the management of large quantities of digital assets, it is compatible with the IIIF Image and Presentation API and is flexible and adaptable to different needs such as protection, conservation and open source code.

In November 2022, Haltadefinizione opened a branch in Germany, to reach out to the international market, providing its technological expertise and exclusive services to museums around the world. The objective, also at the European level, remains the protection and enhancement of cultural institutions and the promotion and dissemination of our cultural heritage through digital transformation projects.

Endnotes

1 A notable example that combines the digitization of Leonardo's writings and their publication within an innovative model of a digital library is the project Leonardo//Thek@-Codex Atlanticus, curated by the Galileo Museum in Florence, cf. Galluzzi, P. (2022) Leonardo//thek@ 1.0: a digital infrastructure to avoid being shipwrecked in the ocean of data of the Codex Atlanticus, in Galluzzi P., Nova A. (ed. by) Decoding Leonardo's codices: Compilation, dispersal, and reproduction technologies, Venezia: Marsilio. Regarding the extended bibliography on Digital Humanities, see Tomasi F. (2022) Organizzare la conoscenza: digital humanities e web semantico: un percorso tra archivi, biblioteche e musei, Milano: Editrice bibliografica, Previtali G. (2022) Che cosa sono le digital humanities, Carocci, Roma, Ciotti F. (ed. by) (2023) Digital Humanities: Metodi, strumenti, saperi, Roma: Carocci.

2 Regarding digital storytelling projects related to Leonardo's works, see Marani P. C., Apollonio F. I., Gaiani M., Barsanti R. (2022) Dentro i disegni: tecnologie virtuali per la fruizione dell'opera grafica di Leonardo da Vinci, in Costa S., Cordera P., Poulot D. (ed. by) Storytelling. Esperienze e comunicazione del Cultural Heritage, Bologna: Bologna University Press.

3 Measures were undertaken to address the fragility of the artwork during the most recent extensive restoration intervention, cf. Brambilla Barcilon P., Il restauro, in Brambilla Barcilon P., Marani P. C. (1999) Leonardo. L'Ultima Cena, Milano: Electa.

4 The virtual tour is available on the website of the Cenacolo Vinciano at the following link: https://cenacolovinciano.org/ultima-cena-percorso-halta/

5 Regarding the transformation project for the visitors' itinerary at the physical site, please refer to https://cenacolovinciano.org/en/news-ed-eventi/new-visitors-itinerary-and-new-spaces-at-the-museum-of-leonardos-last-supper/

Bibliography

Brambilla Barcilon P., Marani P. C. (1999) *Leonardo. L'Ultima Cena*, Milano: Electa.

Ciotti F. (ed. by) (2023) *Digital Humanities: Metodi, strumenti, saperi*, Roma: Carocci.

Costa S., Cordera P., Poulot D. (ed. by) (2022) *Storytelling. Esperienze e comunicazione del Cultural Heritage*, Bologna: Bologna University Press.

Galluzzi P. (2022) *Leonardo//thek@ 1.0: a digital infrastructure to avoid being shipwrecked in the ocean of data of the Codex Atlanticus*, in Galluzzi P., Nova A. (ed. by), *Decoding Leonardo's codices: Compilation, dispersal, and reproduction technologies*, Venezia: Marsilio.

Marani P. C., Apollonio F. I., Gaiani M., Barsanti R. (2022) *Dentro i disegni: tecnologie virtuali per la fruizione dell'opera grafica di Leonardo da Vinci*, in

Costa S., Cordera P., Poulot D. (ed. by) *Storytelling. Esperienze e comunicazione del Cultural Heritage*, Bologna: Bologna University Press.

Occhipinti C. (2020) *Cloni di Leonardo: scritti su arte, umanesimo e tecnologia*, Roma: Dei Merangoli.

Previtali G. (2022) *Che cosa sono le digital humanities*, Roma: Carocci.

Tomasi F. (2022) *Organizzare la conoscenza: digital humanities e web semantico: un percorso tra archivi, biblioteche e musei*, Milano: Editrice bibliografica.

Website Bibliography

https://www.openculture.com/2017/07/leonardo-da-vincis-visionary-notebooks-now-online-browse-570-digitized-pages.html

https://www.openculture.com/2018/08/leonardo-da-vincis-earliest-notebooks-now-digitized-and-made-free-online.html#google_vignette

https://www.openculture.com/2019/05/a-complete-digitization-of-leonardo-da-vincis-codex-atlanticus.html

http://codex-atlanticus.ambrosiana.it

https://scholarworks.iu.edu/journals/index.php/sdh/article/view/27719/35525

https://franz-fischnaller.com/last-supper-interactive-by-franz-fischnaller/

Abstract

The article aims to explore recent opportunities for the digital enhancement of Leonardo da Vinci's Last Supper made possible through the gigapixel image acquired by Haltadefinizione. The analysis begins with an analysis of the immersive project LSI - Last Supper Interactive, recently presented at the Ars Electronica Center in Linz. Subsequently, it explores collaborations between Haltadefinizione and the Museo del Cenacolo Vinciano, which have revolutionized online accessibility to the masterpiece through engaging paths of interactive storytelling.

Keywords

Digitization; Gigapixel; Enhancement of cultural heritage; Conservation; Leonardo da Vinci

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