# ‘The simulacrum is true’ -
# On the Digital Materiality of Virtual Cultural Heritage Projects

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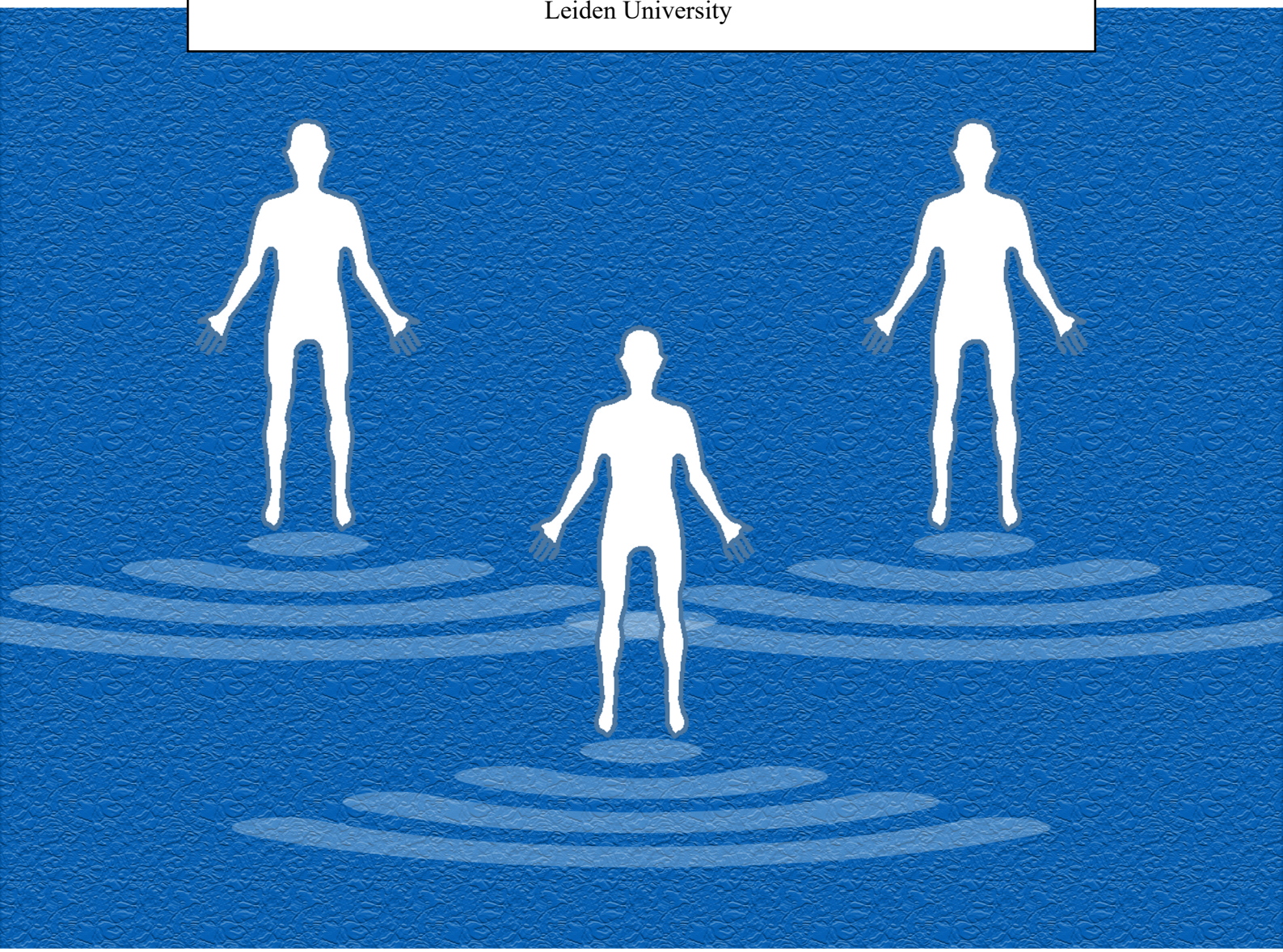

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*1. Rendering the past digitally: a panoramic overview*

Imagine, if you will, the following:

You walk along a historic canal street in Amsterdam, and see an old-fashioned painter's shop selling various ink pots, brushes and canvases. Curious, you step inside and immediately, a text bubble floats up on the left side of your field of vision, informing you that this store was once owned by famous sixteenth-century painter Dirck Barendsz, and frequently visited by other prominent artists of this period. You look around, in awe of the wooden beams in the high ceiling, the old-fashioned furniture, the countless art utensils you have never seen before. As your gaze lingers on an ornate clock on the wall, another bubble appears, only this time it contains an image, a portrait of the man who made it. The floating image expands to reveal a short text, informing you that this clockmaker lived on the same street and was, as indicated by archival letters, a good friend of Barendsz'. A trail of smoke rises from a pipe on the countertop, and without touching it, you know that the tobacco inside it is still warm. It seems as though Barendsz has only stepped out for a short while, and could come back any second now. At this point, you feel that you have done enough time-travelling for the day, and remove your VR goggles.

The fictitious virtual reality scenario outlined above envisions a technologically mediated encounter with the past, in which a person accesses a virtually simulated historical location. This digital space is created on the basis of knowledge derived from archival material and wider historical research. Subsequently, selected elements of this environment are enriched with contextualising information (represented, in this example, by the text and image bubbles). An artistic touch is noticeable in non-archival but nevertheless plausible features. In this example, the still-smoking pipe suggests a tactile sense of temperature and smell, further adding to the immersive and multisensorial realism of the environment. While technically possible, the introductory scenario remains, as of yet, a purely speculative vision, which is not reflective of what most cultural heritage institutions offer their visitors today. On the whole, virtual reality devices like Facebook's Oculus, HTC's Vive, Sony's Morpheus and Microsoft's HoloLens have become more widely commercially available in recent years, and the game and entertainment industries are pivoting towards producing content which caters to these new technologies. Digitally simulated historical environments, on the other hand, have yet to establish themselves as part of the standard experiential repertoire offered by most museums, exhibition spaces, or other institutions providing in-person access to culturally meaningful artifacts or spaces. However, given the rapidly expanding scope of virtual and augmented reality technologies, as well as the politically mandated push for extensive open access

and digital heritage preservation, a more immersive and interconnected experience of digital cultural heritage is certainly on the cards for the foreseeable future. This thesis aims to explore the challenges and possibilities faced by heritage projects which are currently moving in this direction, pioneering the application of virtual and augmented reality technologies to cultural objects and sites around the globe. In doing so, this thesis will attempt to delineate what the digital reconstruction and simulation of material carriers of cultural meaning can reveal about the nature of materiality itself.

An organisation which has shown itself to be exceptionally ambitious in moving towards a virtual reconstruction of the past is the Amsterdam Time Machine (ATM). In cooperation with partner projects launched in Venice, Antwerp, Barcelona, Budapest, Utrecht, Vienna and Paris, the Amsterdam arm of the European Time Machine has made impressive strides in creating 3D models of historic local sites, including the aforementioned painter's shop of Dirck Barendsz on Warmoesstraat 138. The interiors of Barendsz' shop, created using GIS geospatial software, are currently displayed on their website, although they are by no means as informationally enriched, artistically enhanced or virtually traversable as the fictitious introductory scenario envisions.[1]

Figure 1: A preview of a 3d model of Dirck Barendsz' painter's shop, created by Amsterdam time Machine.[2]

[1] Amsterdam Time Machine, '3D model of a painter's shop in Warmoesstraat 138' <https://amsterdamtimemachine.nl/3d-model-of-a-painters-shop-in-warmoesstraat-138/> (30 June 2020).
[2] Image shown here is the final image on Amsterdam Time Machine, '3D model of a painter's shop in Warmoesstraat 138' <https://amsterdamtimemachine.nl/3d-model-of-a-painters-shop-in-warmoesstraat-138/> (30 June 2020).

As a 3D model of a specific historic location, the Barendsz project works on an interesting middleground in terms of its scale and ambition. It provides a kind of 'micropanorama' of the past, which is both more complex and multifaceted than the digital representation of a single artifact, but also more focused and constrained than the reconstruction of an entire city. In its manifesto, published in May 2019, Time Machine claims one of its primary goals to be the creation of exactly such 'new interpretative models that can smoothly transition between the micro-analysis of single artefacts and the large-scale complex networks of European history and culture.'[3] Detailed, multidimensional reconstructions of interior spaces seem to serve as a particularly relatable access point for cultural heritage. Under the influence of the so-called *spatial turn*, ATM states its underlying motivation in the following way:[4]

> 'The intention of the project was to explore virtual interiors as interfaces to historical data. While historical data can often be studied by way of quantification, qualitative close-reading and the identification of 'longue durée' patterns, could 3D modelling it show us something else — something that only spatial perception can offer?'[5]

Here, Amsterdam Time Machine works under the assumption that spatial perception itself poses a new methodology for acquiring knowledge. According to ATM, digital environments which successfully simulate a sense of spatial perception and bodily presence, also known as proprioception, constitute a distinct mode of empirical research. The theory here is that to the subjective human consciousness, the experience of its displaced embodiment within a digital space can unlock new insights, which may be just as enlightening to historians and researchers as they are exciting to tourists or the general public. In the mission statement above, ATM largely justifies its pursuits through the intellectual value and perspective that can be gained from experiencing the digitally mediated materiality of virtual historical locations.

The relatively well-developed Amsterdam arm of the European Time Machine boasts a collection of image previews of historical 3D interiors and exteriors on its website, but has yet to lay out concrete plans on the exact framework within which these digital environments will become accessible to prospective interest groups. It remains unclear whether the plan is to eventually make these digital spaces explorable through an online application, for which an internet connection and a

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[3] Time Machine EU, 'Time Machine Manifesto - Big Data of the Past for the Future of Europe', May 2019 <https://www.timemachine.eu/wp-content/uploads/2019/06/Time-Machine-Manifesto.pdf> (22 February 2020), p. 3.
[4] An academic monograph which exemplifies this school of thought is D. Bodenhamer, J. Corrigan and T. M. Harris, *The Spatial Humanities: GIS and the Future of Humanities Scholarship* (Bloomington: Indiana University Press, 2010).
[5] Amsterdam Time Machine, '3D model of a painter's shop in Warmoesstraat 138'.

standard operating system would be sufficient, or whether it would have to be accessed through a more immersive and expensive VR or AR set-up. Adopting the latter option, namely AR or augmented reality, would perhaps be the more challenging technological strategy to take, as it requires an almost seamless overlay of material reality with a digital surplus. The general idea with augmented reality is to erase the distinctions between the real and the virtual, so that, at least on the level of moment-to-moment experience, they become difficult to separate from one another. Hoshang Kolivand, a researcher who has developed AR applications for cultural heritage sites, defines augmented reality by its creation of 'interactive interfaces' which provide the illusion that 'physical and virtual worlds are connected together and that users can physically cross from one to the other.'[6] According to Kolivand and his team, a wide array of complex issues need to be resolved for a convincing AR experience to come about: individual objects need to be realistically reconstructed and placed, retain object permanence within the real-life setting, and respond to human engagement in a timely manner through accurate temporal adjustment. Creating comfortable, non-obstructive gear and ensuring a degree of interoperability between systems are only a few of the many challenges that move into view for ambitious AR projects. On a much more basic scale, firms like Intel or Google have launched products such as the Vaunt smartglasses or Google Glass, respectively. However, as of yet, the utility of these smartglasses has not extended far beyond providing a few square centimeters of extra screen space for smartphone notifications. Technologically, there is still much more work to be done before smartglasses are developed to the extent where they can project integrated vistas of digital reality onto the real world in front of them. For now, VR, i.e. the simulation of a physical reality model within an entirely virtual space, likely poses a more attainable and thoroughly developed technology for a project like ATM than its hybrid sibling, AR. As of May 2019, the European Time Machine counted 300 partner researchers and organisations from 34 countries,with a target of securing the support of 2000 organisations worldwide by 2020.[7] However, since the project is currently, at the time of writing, still on hold, it may be the perfect moment to pause and reflect in greater depth on the philosophical and cultural implications, possibilities and challenges of digitally simulating historical spaces and objects.

In an article on the Venice Time Machine in *Nature*, Alison Abbott outlines that for Venice, a cadastral map from 1808, census data from 1740, and architectural clues derived from Canaletto paintings were evaluated and combined to map out the city in the late 18th century and to

[6] Section 2 in H. Kolivand, A. El Rhalibi, M. Tajdini, S. Abdulazeez and P. Praiwattana, 'Cultural Heritage in Marker-Less Augmented Reality: A Survey', in: *Advanced Methods and New Materials for Cultural Heritage Preservation* (London: Intechopen, 2018). <https://www.intechopen.com/books/advanced-methods-and-new-materials-for-cultural-heritage-preservation/cultural-heritage-in-marker-less-augmented-reality-a-survey> (02 March 2020.)
[7] Time Machine EU, 'Time Machine Manifesto - Big Data of the Past for the Future of Europe', p. 3.

eventually produce an animated tour.[8] A spatiotemporal simulation of the century-long development of the Rialto district, dating back to 950 AD, is also available in video format.[9] Furthermore, a social network map in which buildings are tagged with the business and families they housed is also among the desired outcomes.[10] For reference, a comparable simulation of Rome in 320 AD was also achieved by the Rome Reborn VR project, which strives to make the historic city explorable through video tours, PC applications and VR software.[11] Although most chapters of the European Time Machine are, at present, still quite far away from offering this degree of immersion, the course of action towards a similarly ambitious package of VR experiences is already planned out in its manifesto. In this document, the European Time Machine claims to work towards '[offering] a realistic scenario to progressively move from dense information networks to actual 4D worlds.' In terms of workflow, this involves '[jumping] from using a dense network of information, the result of transparent interpretation processes from reliable sources, to a continuous simulation representing the multi-scale evolution of the city and its population.'[12] Furthermore, the manifesto speaks of the educational promise a project like Time Machine holds, foreseeing 'immersive and interactive'[13] open online courses to be developed based on these vast aggregations of data. Some skepticism, however, ought to be applied to this public document, which is less of an internal progress report than a promotional communiqué, intended to advertise and secure funding. The admirable vision that '[m]ass scale digitisation will remove spatial and temporal barriers to cultural heritage' escalates - without much practical explanation - into bold and convoluted promises of individually customisable 'multi-sensorial experiences of historic sites', leaving out important information as to which senses will be engaged and which exact technologies will be used.[14] The manifesto also envisions '[f]our-dimensional cinema and virtual reality experiences on large (amusement park) and small (AR/VR headsets) scales' which 'will represent a new market for photorealistic 3D models and digitised audio-visual assets.'[15] Judging from the material that is available to the public, it seems that the European Time Machine lacks a certain degree of coherence and focus, eagerly communicating what may be technically possible, instead of what is

[8] See A. Abbott, 'The "Time Machine" Reconstructing Ancient Venice's Social Networks', in: *Nature* 546, 7658 (2017), p. 343.
[9] For a video of the Rialto district development, see Venice Time Machine,'Venice 4D - Rialto district (950-Now)', 19 August 2016 <https://www.youtube.com/watch?v=f8JVLPwmMF4 > (30 June 2020). For a video on the archival work necessary for the digital cityscape reconstructions, see Nature Video, 'A virtual time machine for Venice', 14 June 2017 <https://www.youtube.com/watch?v=uQQGgYPRWfs> (30 June 2020).
[10] See A. Abbott, 'The "Time Machine" Reconstructing Ancient Venice's Social Networks', p. 343-344.
[11] Rome Reborn Virtual Reality, 'About us', <https://www.romereborn.org/content/aboutcontact> (04 March 2020).
[12] Time Machine EU, 'Time Machine Manifesto - Big Data of the Past for the Future of Europe', p. 9.
[13] Ibidem, p. 14.
[14] Ibidem, p. 19.
[15] Ibidem.

actually feasible from a research and resource-related perspective. In fairness, the ambiguity regarding its concrete objectives may be partially explained by the project's geographical and organisational dispersion, as it runs multiple independent operations across Europe.[16]

By contrast, other projects already exhibit more conceptually focused objectives and have successfully realised the implementation of VR and AR into cultural heritage. Next to the previously mentioned Rome Reborn VR project, the UNESCO-affiliated non-profit organisation CyArk offers free and open VR access to over a 100 heritage sites worldwide. Founded in 2003, CyArk uses reality capture technology, more specifically LiDAR (Light Detection and Ranging) scans taken from the ground and from aerial footage, to create 3D surface models of entire heritage sites, as well as the singular artifacts and archeological elements that constitute them.[17] The project has enriched these models with contextualising information in the form of information texts, and is working towards further enhancing them with audio clips of archeologists describing these sites. CyArk's generous 'Explore' interface encourages users to browse dozens of cultural heritage sites from across the globe, and to select different modes of interaction with their digital reconstructions. Next to introductory information slides and photographs found under the 'Intro' and 'Exhibit' tabs, CyArk users can navigate to the 'Open Heritage' tab, leading them to CyArk's metadata on the object, and further relaying them to location data accrued by Google Arts & Culture. The option 'Virtual Tour' allows users to pan around a 360° photographic panorama of the location, and to intuitively move around the site from one captured location to the other (CyArk's Mount Rushmore digitisation provides a good example of this).[18]

[16] Time Machine EU, 'Home', <https://www.timemachine.eu/timemachines/> (30 June 2020).
[17] CyArk, 'About', <https://www.cyark.org/about/> (04 March 2020).
[18] CyArk, 'Mount Rushmore National Memorial', 'Overview', <https://www.cyark.org/projects/mount-rushmore-national-memorial/overview> (30 June 2020).

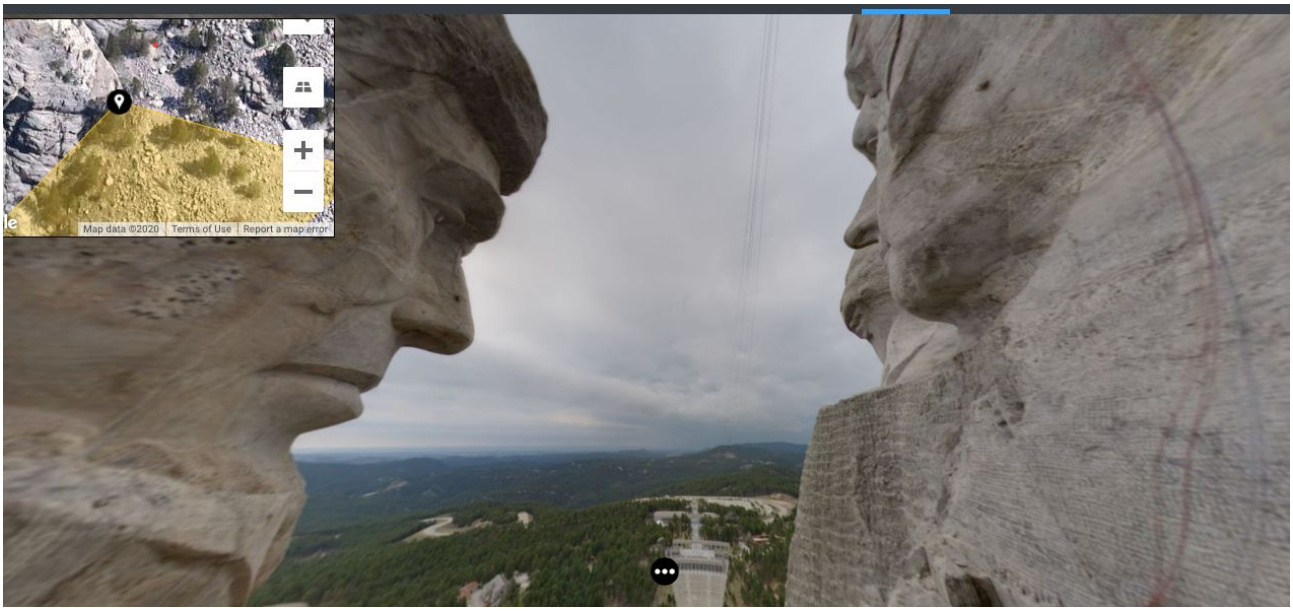


Figure 2: Screenshot of 'Virtual Tour' vista of CyArk's Mount Rushmore National Memorial.[19]

By far the most distinguished achievement of CyArk, however, is its '3D Explore' option, which allows users to move around high-resolution heritage sites that were digitally replicated using LiDAR technology. To become visible from all angles and distances, each heritage site can be adjusted and swivelled around within the parameters of an embedded viewer, but can also be explored and downloaded via the external platform Sketchfab. Through the 'Model Inspector' tool, users can view the 3D model at different stages of its creation, which includes different stages of colour processing, or simply seeing the geometric scaffolding that underlies the end-product. In addition, users have the option of amplifying the immersivity of the experience through the use of VR, either by connecting their smartphones to a commercially available cardboard VR headset, or by viewing the model through a WebVR compatible browser and hooking it up to their personal VR device. At its foundation, CyArk aims to digitally preserve culturally significant objects and locations in their present-day condition, in order to ensure their accessibility for contemporary and future generations, and to withstand any impending damages incurred due to climate change or political conflict. With a damaged Armenian khachkar, or cross-stone, such digitally reconstructive efforts were launched through the use of photogrammetry technology, in which 3D models are created on the basis of older photographs of the then-intact object.[20]

[19] Screenshot taken from CyArk, 'Mount Rushmore National Memorial', Virtual Tour, <https://www.cyark.org/projects/mount-rushmore-national-memorial/virtual-tour> (30 June 2020).
[20] CyArk, 'A video of a photogrammetry reconstruction of a Khachkar from Geghard' (Armenia), via: Google Arts & Culture, 18 January 2018 <https://artsandculture.google.com/asset/a-video-of-a-photogrammetry-reconstruction-of-a-khachkar-from-geghard-cyark/TQG5V6o0z8_Rgw?hl=en> (30 June 2020).

In CyArk's online promotional material, the destruction of the ancient Bamiyan Buddhas in Afghanistan is cited as the catalyst for founders Ben and Barbara Kacyra to pursue this comprehensive digital preservation project.[21] Incidentally, the later reconstruction of these Buddhas, which involved the projection of holographic laser statues in place of the lost monument, presents a relevant example of the implementation of augmented reality in the cultural heritage field. In 2015, 14 years after two 1700 year-old Buddha statues were destroyed by the Taliban in rural Afghanistan, Chinese investors and the UNESCO cooperated to reconstruct the fallen monument. Early plans to replace the larger one of the two Buddhas with a physical reproduction, made of a silicone compound, were met with legitimate concerns. The main criticism raised centered around the symbolic erasure of the monument's complicated history that a simple physical replacement would represent. In the words of human rights activist Abdullah Hamadi, '[t]he Buddha was destroyed ... If you made it, rebuilt it, that is not the history. The history is the broken Buddha.'[22] In the interest of retaining the destroyed monument as a harrowing testament to the destructive forces of war and fundamentalism, the empty sandstone cavern where the Buddha had once stood was not filled with a material replica, but instead augmented with a 3D laser projection. This approach follows a restorative principle that is more sensitive towards the tragic absence of the original. The holographic projection was developed by ETH Zurich, and 'performed on three different data-sets in parallel and using different photogrammetric techniques and algorithms.'[23] In order to create a faithful and realistic projection, the Buddha's general structure was reconstructed from Internet images using standard photogrammetry software, while smaller details like the folds in its dress were added with the help of manually completed photogrammetric measurements.[24] In an almost parallel development, the still-intact Great Buddha of Kamakura in Japan has been digitised in a similar 3D modelling procedure (albeit without the conversion into a holographic projection), which is outlined in detail by software specialists Katsushi Ikeuchi, Takeshi Oishi and Jun Takamatsu in 2007.[25]

Despite the high level of geometric realism that may be achieved by many of these 3D scanning treatments, the Bamiyan Buddha remains an unmistakably and unapologetically digital object. The laser structure glows semi-transparently against the pale sandstone backdrop, unable to

[21] CyArk, 'About', <https://www.cyark.org/about/> (04 March 2020).
[22] J. Kakissis, 'Bit by Bit, Afghanistan Rebuilds Buddhist Statues', in: *NPR*, 27 July 2011 <https://www.npr.org/2011/07/27/137304363/bit-by-bit-afghanistan-rebuilds-buddhist-statues?ft=1&f=1004&t=1583329404280> (04 March 2020).
[23] A. Grün, F. Remondino and L. Zhang, 'Photogrammetric Reconstruction of the Great Buddha of Bamiyan, Afghanistan', in: *Photogrammetric Record* 19, 107 (2004), p. 177.
[24] See ibidem, p. 179.
[25] Ikeuchi, Katsushi, et al., 'The Great Buddha Project: Digitally Archiving, Restoring, and Analyzing Cultural Heritage Objects', in: *International Journal of Computer Vision*, vol. 75, 1 (2007), pp. 189–208.

create an illusion of solidity or substantial density. Its artificial lucidity distinguishes the Buddha from the uncanny pseudo-materiality that is arguably evoked by some of CyArk's 3D models or even by the Kamakura Buddha project.

Figure 3: Holographic reconstruction of the Bamiyan Buddha in Afghanistan.[26]

Interestingly, it seems that digitisation projects in the field of VR, embedded into an entirely virtual framework, seem to be more successful at replicating a visually realistic impression of materiality. Conversely, AR-adjacent digitisations like the Bamiyan Buddha, which are projected onto the material world with the intention of 'blending in', only pronounce the stark contrast between the real and the artificial, between the solid and the simulated, even more. It is yet to be seen whether technology will ever resolve this incongruity and advance to a stage where these polarised qualities no longer work in opposition to each other. Another challenging circumstance for the holographic Buddha is that it is not experienced via a screen, a technical medium which could work to mitigate and relativise the blunt artificiality emanating from the digital object. Instead, the Buddha has to convincingly and impressively appear on the 'interface' of unmediated human vision.

[26] Image taken from R. Nordland, '2 Giant Buddhas Survived 1,500 Years. Fragments, Graffiti and a Hologram Remain', in; *The New York Times*, 18 June 2019 <https://www.nytimes.com/2019/06/18/world/asia/afghanistan-bamiyan-buddhas.html> (30 June 2020). Photography credit: J. Huylebroek.

The holographic Buddha is not a permanent installation, and is only shown to audiences on occasion. Unlike its century-old predecessor, it is not continually existent, but depends on the presence of electricity and technological devices to appear at certain intervals. When it does appear, however, it never flickers, nor does it ever change shape, colour or position - its appearance is more or less static, and unlike its weather-beaten original, it is not compromised by degradation over time. The digital monument's relationship with time and temporal continuity, then, is not only twofold, but downright contradictory. Digital studies theorist Paul M. Leonardi proposed an encompassing definition of materiality which recognises the role of temporality, but which, unfortunately, only partially accommodates objects like the Bamiyan Buddha. For Leonardi, materiality, especially in the context of 'a technology's materiality', is not synonymous with 'physicality'. Leonardi defines this materiality as 'the arrangement of an artifact's physical and/or digital materials into particular forms that endure across difference in place and time'.[27] This definition is based on one which was originally put forth by Philip Faulkner and Jochen Runde. In a symposium on the ontology of non-material objects, Faulkner and Runde distinguish between objects (which are temporally and spatially stable 'continuants') and events (which are temporally and spatially transient 'occurrents').[28] Regarding the previous point around its twofold temporality, the holographic Buddha arguably falls into both of these groups: it is a spatial 'continuant', but a temporal 'occurrent'. From a practical perspective, then, the idea that temporal continuity versus temporal intermittency are good indicators of whether one is dealing with a digital object or not is problematic. If anything, this approach may perhaps be more applicable to VR objects than AR objects. Ensuring the stable existence of an object within an entirely digital VR landscape is a small feat compared to the nearly impossible challenge of creating an augmentary digital object that retains its ontological permanence within a real-world surrounding for an indefinite amount of time. While the Buddha may not be visible day and night, it is still a 'continuant', to use the terminology above, for the duration of the installation. In fact, its infrequent appearance may actually be part of its desired effect, and does not take away from its status as an object that is, in a strictly digital sense, 'material'. Intermittently casting a holographic overlay (i.e. the Buddha) over a real, geological canvas (i.e. the sandstone cavern) constitutes a form of heritage preservation that does not attempt to undo or gloss over the loss of the material original. Instead, the digitally created augmentation plays on its own fleeting intangibility, and utilises the unique affordances of digital

[27] P. M. Leonardi, 'Materiality, Sociomateriality, and Socio-technical Systems: What do these terms mean? How are they different? Do we need them?', in: *Materiality and organizing*, ed. P. M. Leonardi, B. A. Nardi and J. Kallinikos (Oxford: Oxford University Press, 2012), p. 31.

[28] See P. Faulkner and J. Runde, 'The Social, the Material, and the Ontology of Non-Material Technological Objects', paper presented at the *European Group for Organizational Studies (EGOS) Colloquium* (Gothenburg, 2011), p. 3.

technology to highlight - quite literally - the lost physicality of the original. Unlike many other AR applications, the Bamiyan installation seeks to accentuate rather than obscure the distinction between the digital and the analogue, while still facilitating an alternative experience of the Buddha's 'aura' for generations to come. With an example like the Bamiyan Buddha in mind, we can not only begin to grasp the nuanced possibilities that are opening up through innovative digital preservation strategies, but can also better understand how conventional materiality is constructed in the first place.

Arguably, the cultural heritage sector is a particularly challenging terrain for VR and AR technologies to make inroads into. Much of the subjective thrill and value derived from the historical and artistic objects showcased by this sector is, after all, strongly connected to encountering objects and artifacts 'up-close', in their physical presence. What, then, can VR and AR tools offer institutions for which the auratic value of cultural objects is so deeply intertwined with their material presence, and which financially depend on providing commercial in-person access? Legitimate doubts are also launched by researchers within the psychological or medical fields. Prominent consciousness-scholars like Michael Madary and Thomas Metzinger raise important ethical concerns around the impending ubiquity of VR. Their paper 'Real Virtuality' questions the long-term effects of digitally displacing our sense of embodiment over extended periods of time.[29] It is clear that increasingly prevalent VR and AR tools may come as a somewhat unpredictable catalyst for disruption, renegotiation and innovation - particularly for a sector that has traditionally been so invested in preserving the material authenticity of its heritage objects, and in fostering a collective memory practice around physical objects and locations. VR and AR digitisations signify a radical departure from this old paradigm, as they not only approximate our conventional experience of materiality, but also transform it, retroactively reframing the material original. Haidy Geismar's highly relevant book *Museum Object Lessons for the Digital Age* critically aims to 'make sense of digital collections as objects in their own right...'[30] What does it mean to understand a digitally catalogued item not merely as a reproduced schema, but as a new category of object in and of itself? This thesis will join Geismar's book in operating on the basic premise that 'imagining the digital/analogue as a divide (rather than a continuum) is not a particularly productive way of understanding the particular materiality'[31] of digitised objects.

[29] See M. Madary and T. Metzinger, 'Real Virtuality: A Code of Ethical Conduct. Recommendations for Good Scientific Practice and the Consumers of VR-Technology', in: *Frontiers. Robot. AI,* 19 February 2016 <https://doi.org/10.3389/frobt.2016.00003> (01 May 2020).
[30] H. Geismar, *Museum Object Lessons for the Digital Age* (London: UCL Press, 2018), p. xviii.
[31] Ibidem.

Overall, any stark dichotomisation between the digital and the material needs to be treated with a healthy degree of skepticism. At this point, there is an acute urgency for rethinking the stark dichotomisation between the digital and the material, as well as the superiority of the uniquely 'authentic' material object - especially at a time when its digital enhancement and/or reproduction holds so much potential for barrier-free access, engagement and interactivity. It is undeniable that just as our experience of material reality influences our development of its digital equivalent, so do the digital medium's affordances change our experience of the material. This mutually dependent relationship deserves to be considered and explored through a wider interdisciplinary lens. Thinking along and against the lines of philosophers like Plato, Immanuel Kant, Johann Gottfried Herder, Walter Benjamin and Jean Baudrillard, and taking into consideration recent digital humanities research on digital materialism, preservation, as well as VR and AR aesthetics and technologies, this thesis works towards the dissolution of the conceptual duality between the material and the digital, and attempts a phenomenological synthesis of a 'digital materiality' for the future.

## *2. Conceptualising pre-digital materiality*

To understand the precise ways in which materiality is challenged by emerging digital contexts, it is worth taking a closer look at how materiality, or material reality, has been conceptualised *before* digital technology began to simulate it. Philosophical conceptualisations of the nature of materiality, or more concretely, the material nature of objects, can give crucial support to digitisation projects, directing them towards the essential components of material experience and facilitating their recreation.

To this point, the materiality concept developed by German Enlightenment philosopher Immanuel Kant offers a suitable entry point. Kant's systematic critique of reason stands as the defining fault line along which philosophers have oriented themselves in the 18th century and onwards. Less well known are Kant's ontological grapplings with the nature of reality and matter, formulated in his *Metaphysical Foundations of Natural Science* [*Metaphysische Anfangsgründe der Naturwissenschaft*] from 1786. These *Foundations* are particularly instructive for thinking about materiality and, by extension, its digital manifestation. In this work, Kant ascribes the two useful concepts of impenetrability [*Undurchdringlichkeit*] and expansive capacity or force [*Ausdehnungsvermögen* or *Ausdehnungskraft*] to the fundamental nature of matter: 'Impenetrability, as the fundamental property of matter, whereby it first manifests itself to our outer senses, as

something real in space, is nothing but the expansive power of matter.'[32] The expansive power referred to here does not require objects to actively extend outwards in motion in order for them to be considered material. Rather, Kant is saying that:

> '[Matter] is grounded only on that property whereby it fills a space – which, by means of the sense of feeling, provides us with the quantity and figure of something extended, and thus with the concept of a determinate object in space…'[33]

These entangled concepts of impenetrability and expansivity work in tandem to describe the general ability of material to occupy and fill space with a unified substance. To illustrate the Kantian delineation of the material, one can consider, for a moment, the example of an ordinary kitchen sponge. The sponge fulfills the requirement of occupying space, but seems to violate, at least at first glance, the second principle of impenetrability. Surely, if a sponge soaks up water, it cannot be described as impenetrable? However, the Kantian materiality of a sponge begins and ends with the structure that is occupied by its synthetic fabric. Water may enter and be contained by the sponge, but it neither breaks apart the sponge's basic material make-up, nor reduces its ability to occupy space. In turn, the water does not simply disappear into thin air upon contact with the sponge, but only changes its shape. As a result, it is able to retain its own, distinct materiality within the caverns inside the sponge.

In some respects, the materiality concept of the *Foundations* may be seen to align surprisingly well with modern physics, which generally relates matter and materiality to the combined presence of mass and volume. The only two massless and therefore arguably immaterial particles are photons (electromagnetic carrier) and gluons (strong force carrier).[34] A ray of light would indeed be immaterial in the Kantian sense as well, fulfilling his criterion of penetrability: light does not occupy space in the same manner as a material object, but can easily be interrupted, broken and converged into a small point. Later on in his *Foundations*, however, Kant narrows down his definition of impenetrability even further: 'substance discloses its existence to us in no other way than through that sense whereby we perceive its impenetrability, namely, feeling, and thus only in relation to contact.'[35] What emerges here is a vital link between the Kantian impenetrability

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[32] I. Kant, *Kant: Metaphysical Foundations of Natural Science*, trans. Michael Friedman, (Cambridge: Cambridge University Press, 2004), p. 46.
[33] Ibidem, p. 47.
[34] M. O'Keefe, 'Massless particles can't be stopped', in: *Symmetry Magazine*, 23 July 2019 <https://www.symmetrymagazine.org/article/massless-particles-cant-be-stopped> (11 May 2020).
[35] I. Kant, *Kant: Metaphysical Foundations of Natural Science*, p. 48.

concept and human touch. In this paradigm, the question of whether something is impenetrable can only be ascertained through its direct contact with the body. In order for something to be material, it is not enough for it to have mass. Instead, a human body needs to *feel* resistance and firmness against its touch to have an indication of the existence of external matter. The Kantian notion of impenetrability, then, is better understood by rerouting it through these adjacent concepts of resistance or firmness to touch. Working within this contact-centric definition, water would be considered 'more' material than air, because the density of a liquid registers more materially resistant to human skin than the density of gas. If a human can feel a gas through touch, it is likely because of its temperature, which is distinct from the interlinked criteria of impenetrability, resistance and density. In any case, air is likely not the kind of matter that a historical digitisation project would be interested in constructing. Thus, returning to a more Kantian conception in heritage digitisation may be advisable, precisely because it defines materiality along the lines of human touch, intuition and perception, rather than scientific criteria like mass or volume.

A similar exaltation of human touch was performed by Johann Gottfried Herder, an important contemporary who was otherwise often at odds with Immanuel Kant. Throughout the 18th century, cultural critics like Alexander Gottlieb Baumgarten, Gotthold Ephraim Lessing and Johann Christoph Gottsched developed various theories around the newly emerging philosophical discipline of aesthetics. In essays and letters frequently published in the so-called *Wochenschriften*, or weekly periodicals, these authors tried to define rules for what constituted good taste, art and beauty. These public intellectuals generally favoured the narrative arts, i.e. plays and poetry, over visual arts like painting and sculpture, deeming the latter to be less intellectually demanding and morally instructive. Herder attempted a further division of the visual arts, believing that aesthetic disciplines needed to be categorised by the senses which they most actively stimulate.[36] Among them, Herder elevated the classical discipline of sculpture above painting and even above theatre. Herder offered the explanation that 'sight reveals merely shapes, but touch alone reveals bodies: [...] everything that has form is known only through the sense of touch and [...] sight reveals only visible surfaces...'[37] Here, Herder sets up a hierarchy among the senses, pitting sight and its perception of two-dimensionality against touch and its uniquely complex perception of three-dimensionality. He argues that because sculpture is the only art form which speaks directly to our tactile sense, it is uniquely equipped to connect with humans on the most basic level of their bodily existence:

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[36] See Sections 5. 1 and 9. in: P. Guyer, '18th Century German Aesthetics', in: *The Stanford Encyclopedia of Philosophy* (Winter 2016 edition), ed. Edward N. Zalta, 3 March 2014 <https://plato.stanford.edu/archives/win2016/entries/aesthetics-18th-german/> (30 June 2020).

[37] J. G. Herder, *Sculpture: Some Observations on Shape and Form From Pygmalion's Creative Dream*, ed. and trans. J. Gaiger (Chicago: The University of Chicago Press, 2002), p. 35.

'Herder theorizes sculpture via the common sense of touch and the common organ of the hand in order to close the gap between mind and body…'[38] On this matter, prominent Herder scholar and translator Jason Gaiger poignantly describes Herder's conception of physical touch as a prerequisite for human self-consciousness and of our existential feeling of separation from the external world:

> 'In place of Descartes' cogito ergo sum [I think therefore I am], [Herder] asserts,"Ich fühle mich! Ich bin!"[I feel! I am!]. Our embodied, sensuous existence provides the indispensable condition for genuine self-awareness.'[39]

Herder's touch-centric aesthetic philosophy may, at first glance, seem incompatible with the effort of cultural heritage institutions to render monuments and sculptures using digital technology. While virtual 3D models may be able to emulate the appearance of an object in a way that *suggests* its surface texture and physical dimensionality, they cannot - at least as of yet - directly transfer these sensory impressions to human skin. Surprisingly, however, Herder himself accounted for cases in which the touch-based encounter with a material object could be mediated through the effective stimulation of other senses:

> 'The eye that gathers impressions is no longer the eye that sees a depiction on a surface; it becomes a hand, the ray of light becomes a finger and the imagination becomes a form of immediate touching.'[40]

In this rather poetic passage from his notations in *Viertes Wäldchen*, Herder describes how the eye can figuratively transform into a hand. With the help of this manualised eye, in combination with imagination and referential memory, one can deduce a sculpture's tactile and dimensional qualities from a mere visual impression. On second thought, this insight is likely to have stemmed from the simple fact that even in Herder's day, it would have been unusual for art-lovers to appreciate a sculpture simply by reaching out and touching it. The tactile experience of a sculpture was ordinarily reserved for its maker and perhaps its eventual owner. Typically, most people would have had to register the smoothness of a sculpture's surface by eye, and not by hand. Herder's crucial

[38] M. Mack, 'Literature Between Medicine and Religion: Herder's Aesthetics of Touch and the Emerging Field of Medical Humanities', in: *Neophilologus*, vol. 94, 4 (2010), p. 546.
[39] Here, Gaiger cites Herder's 'Zum Sinn des Gefühls', in: J. G. Herder, *Sculpture: Some Observations on Shape and Form From Pygmalion's Creative Dream*, p. 9.
[40] Here, Gaiger cites Herder's *Viertes Wäldchen*, 4:66, in: J. G. Herder, *Sculpture: Some Observations on Shape and Form From Pygmalion's Creative Dream*, p. 19.

realisation, then, is that touch and feeling can be simulated through the intelligent use of other senses, particularly through vision.

Another well-known phenomenon connected to this idea is synesthesia, i.e. a targeted stimulation of one sense in order to produce an effect on another sense. The Herderian idea of visually mediated touch allows for materiality to exist independently of whether it is tangible or not: if an object's appearance is reminiscent of certain textural, structural and dimensional characteristics which we are familiar with, the object may be said to register as visually material. This attention toward visual representation has been observed by contemporary digital humanities scholars, with the likes of museum digitisation specialist Haidy Geismar succinctly stating that 'visual representation is by far the most digitally exploited sense'[41] and iNovel creator Mohammad Ibrahim Aljayyousi further elaborating on 'visiocentrism' as

> '...the centrality of the visual in computational representations [...]. This takes place both paradigmatically, by centralizing form, and perceptually, by centralizing sight. Things are represented by a reproduction of their visual imprint…'[42]

Working to the digital medium's advantage, vision and touch seem to be highly suggestive of each other: one can hardly touch something, even blindly, without immediately imagining its visual appearance. Likewise, when one looks at certain objects, a verdict on what it might feel like is reflexively, almost unconsciously reached. Take, for example, the instant mental impression of softness created upon seeing a silk scarf, versus the sudden sense of discomfort when being shown a rusty cheese-grater.

When considering the digital reconstruction of a sculpture, one could alternatively imagine how sound, alongside vision, might be incorporated into the virtual approximation of its materiality. For example, when moving the sculpture around in the virtual space, a VR user might be able to hear the scraping of heavy stone over wooden floorboards. This conception of materiality-by-proxy, that is to say, a materiality which bypasses the experience of physical touch by stimulating other senses and thereby triggering associative memories of conventional materiality, provides the aesthetic foundation on which projects like Time Machine, CyArk, and even the Bamiyan Buddha operate. One might even say that this synesthetic strategy is a form of sensory remediation. A process already described as universally applicable to all media content by renowned media theorist

[41] H. Geismar, *Museum Object Lessons for the Digital Age,* p. 18.
[42] M. I. Aljayyousi, 'Enter the Digital: Emergent Materiality and the Digitization of Literary Texts: The Novel as a Case Study', in: *Digital Studies/Le champ numérique* 7,1: 3 (2017), p. 7.

Marshall McLuhan, remediation refers to the idea that 'the "content" of any medium is always another medium. The content of writing is speech, just as the written word is the content of print, and print is the content of the telegraph.'[43] In a related manner, the material 'content' of any virtual sculpture is necessarily the visual appearance of a material sculpture: the visiocentric virtual realm subsumes and transforms the touch-centric material realm. In their monograph *Remediation* and other papers on the subject, Jay David Bolter and Richard Grusin adopt this McLuhanian concept as a paradigmatic way of understanding digital media, essentially arguing that 'remediation is a defining characteristic of the new digital media'.[44]

A conceptual rerouting of materiality from the sense of touch over other senses does not, however, solve the problem of grasping the deeper nature of material reality itself. The original problem of defining materiality has its roots in the ontological split between Plato and Aristotle. In Plato's *Republic*, the allegory of the cave outlines a basic situation in which prisoners are tied down in a cave and forced to watch shadows as they dance on a wall in front of them. These shadows are mere representations of puppets, which are held up behind the prisoners who cannot see the shadows' true origin.[45] This allegory serves to illustrate Plato's Theory of Forms, which states that a non-physical Idea (or 'Form') lies at the essential basis of every material object, and that every physical manifestation we perceive is only a flawed representation of a non-physical essence, existing in a realm beyond human perception.[46] Plato conceives of these immaterial ur-Forms as unique and ideal, while their material instantiations are multiple and imperfect. Not only is Form fundamentally separate from matter, it is also existentially superior to it. Somewhat paradoxically, Plato's allegory figuratively treats the immaterial shadows as the flawed material representations, while the material puppets symbolise perfect, idealised Forms. Aristotle, on the other hand, argues that both form and matter are required in combination to give rise to substance.[47] In some sense, the Aristotelian conception of form-matter unity poses a greater challenge for digitisation projects, since the digital object appears to be, at least in the conventional understanding, all form and no matter. Here, one could think that we arrive at an impasse, encountering the limits of consulting Ancient Greek philosophers on the problem of materiality in the context of digitisation.

Nonetheless, conservator Sarah Norris has succeeded in applying these two approaches in relation to her own experience with practical digitisation, and shown how the Platonic/Aristotelian

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[43] M. McLuhan, *Understanding Media: The Extensions of Man* (New York: McGraw-Hill, 1964), pp. 23–24.
[44] J. D. Bolter and R. A. Grusin, 'Remediation' in: *Configurations* 4, 3 (1996), p. 339.
[45] See Book VII in Plato, *The Republic*, trans. B. Jowett (The Floating Press: 2009), pp. 469-72.
[46] C. C. Meinwald, 'Plato', 'Dialectic', 'The Theory Of Forms', in: *Encyclopædia Britannica*, 31 March 2020 <https://www.britannica.com/biography/Plato/Dialectic#ref281701> (30 June 2020).
[47] J. Warrington, *Aristotle's Metaphysics* (London/New York: Dent/Dutton, 1956), p. 18.

duality mirrors the allographic/autographic framework originally proposed by Nelson Goodman in 1968.[48] Norris explains that an autographic or Aristotelian digitisation would try to preserve an object's unique history and material flaws. Conversely, an allographic or Platonic digitisation is more interested in capturing the object in its ideal, original, or reconstructed state. A project like CyArk may be said to more closely follow an Aristotelian approach, creating surface models which capture and maintain the cracks and damages which accumulated over time. Time Machine's painter's shop, by contrast, necessarily falls in line with a Platonic digitisation, as some degree of artistic idealisation will inevitably be at play in its design. Moreover, the absence of any archeological remnants makes it impossible to reconstruct the shop's interior to its full authentic materiality. Arguably, the Platonic conceptualisation runs contrary to a postmodern appreciation of the specific, non-idealised object, while the Aristotelian one complements this tendency to inscribe an object's signatory quirks, flaws and damages with additional layers of meaning. Norris further distinguishes between subject-specific preferences, stating that the former remains pertinent to the study of musical scores or literary texts, while the latter is valued by visual art historians.[49]

No modern thinker is as prominent a representative of the materialist turn as 20th century philosopher and art theorist Walter Benjamin. Influenced by the materialist conception of history that defines Marxist 'historical materialism', Benjamin understood the collisions, motions and transformations of matter to be the determining causes for all social, economic, political and even psychological processes. One can further illustrate this principle with a short excursion into Einstein's theory of general relativity: all mass exerts a gravitational force, which curves - ever so slightly - the space in which it exists. As the name suggests, a materialist thinker will, first and foremost, be concerned with that level of reality which is constituted by matter and materiality. Given that certain material conditions are objectively shared and experienced by entire classes, the material world becomes the primary arena for political struggle to take place. In his seminal essay *The Work of Art in the Age of Mechanical Reproduction* from 1935, Benjamin applied this materialist stance - up until then more prevalent in political and economic theory - to the subjective experience of art. More concretely, Benjamin described how the technological advances of capitalist modernity allowed for the fast and accurate reproduction of previously unique, inimitable works of art. Given his historical circumstances at the time of writing, Benjamin mainly refers to photography and lithography as the mechanical modes of reproduction which enabled the mass production and easy dissemination of older art. Benjamin lamented a loss of 'aura' in these

[48] S. Norris, 'Toward an Ontology of Audio Preservation', in: *Journal of the American Institute for Conservation,* 53, 3 (2014), p. 174.
[49] Ibidem.

reproduced works, stating that 'even the most perfect reproduction of a work of art is lacking in one element: Its presence in time and space, its unique existence at the place where it happens to be.'[50] The aura of an object, then, while itself immaterial, arises from and is inextricably tied to a material point of origin.

Remembering the ancient Greeks, Benjamin's materialist conception of aura reads like an inversion of Platonic idealism. For Benjamin, the 'essence' of a thing rests in its authentic material instantiation, while for Plato, the essence of a thing resides in the realm of Ideas, far beyond its earthly materiality. Overall, it seems that Benjamin's conviction that the 'sphere of authenticity is outside the technical'[51] would not bode well for the practice of digitising cultural and artistic heritage. Nonetheless, the Benjaminian 'aura' concept, while loosely tied to notions of authenticity and originality, remains somewhat difficult to define. In another text, Benjamin rather cryptically states that aura is 'a strange weave of time and space: the unique appearance of a distance [*Ferne*] however close it might be.'[52] Here, aside from pointing out an object's spatio-temporal specificity, Benjamin emphasises an impression of insurmountable distance which arises between an object and its beholder if it possesses authentic 'aura'. According to Benjamin, the subjective sense of untouchability and unattainability that enshrouds a painting in a museum is lost in a photograph of the same painting. While it is impossible to know how Benjamin would have applied or modified his theory in the era of digitally reproduced art, one could argue that the digital medium's dematerialisation of art actually works to *heighten* this central characteristic of distance and untouchability. After all, a digitally rendered artwork, stored in a faraway server, composed entirely of bits and bytes, will always remain more distant and out of reach than any material original, displayed in the physical immediacy of an exhibition space. The geographical dispersion of digital networks introduces a literal distance that likely does not chime with Benjamin's intended formulation of 'distance' as a subjective sense of awe and esteem. However, in fulfilling this slightly skewed interpretation of Benjamin's criterion of 'distance', the digitally rendered object could come to possess its own alternative brand of auratic power.

In the early 1990s, American internet artist Douglas Davis published an 'evolving thesis' entitled *The Work of Art in the Age of Digital Reproduction*, in which he tried to understand the transformation of the Benjaminian aura within the digital medium. Davis' analysis revolves around a central claim in Benjamin's essay, namely that the auratic authenticity of an art object is

[50] F. Frascina, C. Harrison, D. Paul, *Modern Art and Modernism: A Critical Anthology*, (London: Sage, 1982), p. 218.
[51] Ibidem.
[52] W. Benjamin, *Walter Benjamin's Archive: Images, Texts, Signs*, ed. U. Marx, G. Schwarz, M. Schwarz (London, New York: Verso, 2007), p. 45.

'jeopardized by reproduction', meaning that the process of producing copies diminishes the original.[53] This may, of course, come as a somewhat unacceptable conclusion to a digital artist like Douglas Davis or a digitisation professional like the aforementioned Sarah Norris. Both grapple with the problem of how to instill their digital productions with authenticity, and by extension, with 'aura'. In direct contrast to Benjamin, Norris generally sees the multiplication of art as a form of enhancement: 'Each concept enriches the other: the original triggers the copy, and the copy valorizes the original.'[54] However, Norris does acknowledge, to some extent, Benjamin's nostalgia for auratic uniqueness. To recreate this within the digital realm, Norris suggests that each digital copy made of an object should be marked with its own, uniquely distinguishing characteristic. She suggests that this could perhaps be done through a metadata system which automatically ascribes a unique identifier to each copy.[55] Another, slightly more creative solution to this problem might be the automatic generation of unique digital watermarks, which would appear visibly on the files and render each of them an individuated 'original'. In a study on the popular mobile phone game Pokémon Go, marketing researchers Rebecca Mardon and Russell Belk describe the way in which 'auratic indexicality'[56] is created through the use of a digital patina for each individual catch made. The appeal of collectibility of these non-material 'pocket monsters' is successfully simulated, according to Mardon and Belk, through the generation of a unique digital plaque or patina in the pokémon's metadata, recording the exact location and date of each catch. Mardon and Belk argue that digital code 'is a material substance that can, through processes of material configuration involving marketing and design, be altered and shaped to produce digital consumption objects'.[57] Digital objects may 'appear ill-suited to collecting' due to their anonymity, reproducibility and ephemerality, but the development of quasi-materialising features could alleviate these digital shortcomings. Mardon and Belk posit that the digital patina is such a feature, endowing each digital pokémon with the same artificial uniqueness that motivated previous generations of consumers to trade and collect material pokémon cards. From the perspective of a consumer, the introduction of individualising digital patinas works to 'materialize digital consumption objects as elusive and authentic and, in doing so, may facilitate those pleasures of collecting otherwise absent in the digital domain.'[58] The idea is that by anchoring these digital objects, in this case collectable pokémon, into a fixed spatio-temporal context, they are historicised and archived, almost like an archeological

[53] F. Frascina, C. Harrison, D. Paul, *Modern Art and Modernism: A Critical Anthology*, p. 218.
[54] S. Norris, 'Toward an Ontology of Audio Preservation', p. 172.
[55] See ibidem.
[56] R. Mardon and R. Belk, 'Materializing Digital Collecting: An Extended View of Digital Materiality', in: *Marketing Theory* 18, 4 (2018), p. 558.
[57] Ibidem, p. 544.
[58] Ibidem.

object, forever tied to a real location and fixed point in time, and therefore given an auratic quality of their own. Much like Norris, Mardon and Belk are optimistic that 'it is through such mechanisms that the possibility of authentic digital antiques becomes possible.'[59]

Davis, on the other hand, rejects Benjamin's idea of reproductive degradation altogether, especially in the context of the digital. Davis works under the assumption that:

> 'Analog[ue] signals may be compared to a wave breaking on a beach, breaking over and over but never precisely in the same form…[b]ut digital bits, compatible with the new generation of tools that see, hear, speak, and compute, march in precise, soldierly fashion, one figure after another.'[60]

The dichotomy Davis sets up here is that while the analogue is subject to the irreproducible, corruptible, and ever-degrading quality of matter, the digital medium works according to the logic of pure and perfectly repeatable Form. Benjamin's crucial insight was that mechanical reproduction, operating within a solely material world, creates flawed and diversified copies, which in turn diminish the original. The revolutionary power of digital reproduction, by contrast, is that while the initial step of converting the material original into a digital equivalent may entail a certain loss of aura and autographic idiosyncrasy, the digital multiplications themselves are characterised by a stunning uniformity - at least when the digital reproduction technology is functioning optimally. For Davis, then, the shift from mechanical or analogue reproduction to its digital evolution was seismic. In the fully digital era, Davis envisions that:

> 'There is no longer a clear conceptual distinction between original and reproduction in virtually any [digital] medium. These two states, one pure and original, the other imitative and impure, are now fictions.'[61]

For Davis, the possibility of digitally reproducing art finally and totally closes the auratic gap between original and copy: 'digitalization [ = digitisation] transfers this aura to the individuated copy.'[62] Davis' radical stance is perhaps more convincing when applied to the reproduction of digital-born objects, which were never endowed with physical materiality in the first place.

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[59] R. Mardon and R. Belk, 'Materializing Digital Collecting: An Extended View of Digital Materiality', p. 559.
[60] D. Davis, 'The Work of Art in the Age of Digital Reproduction - An Evolving Thesis: 1991-1995', in: *Leonardo* 28, 5 (1995), p. 382.
[61] Ibidem, p. 381.
[62] Ibidem.

Unfortunately, Davis' paper never explicitly addresses the more complicated leap that occurs when converting a material original into a digital object. For Benjamin, however, the initial step of taking a material original and deriving from it a mechanically manufactured copy was pivotal.

With its dematerialised mode of reproduction, the digital medium may be able to overcome Platonic theory, according to which a single, ideal Form provides the template for the existence of a multitude of flawed manifestations. In the digital transcendence of this paradigm, a single set of computer code (= puppet in the cave) can produce thousands of identical, equally immaterial objects (= shadows), provided that the individual hard- and software used do not give rise to differentiated renderings. The digital realm, then, allows Platonic Forms to reign supreme, while imperfect materiality conveniently falls out of the picture. As later explanations will show, however, the conventional distinction between the analogue (behaving like matter) and the digital (behaving like form) have been heavily contested by many theorists since. While an understandable supposition, Davis' idea that digital copies are always transmitted perfectly from one instance to the next can and should be problematised, especially when considering the often flawed technological realities of computer soft- and hardware.

From the range of diverse and sometimes conflicting conceptions discussed in this chapter, it becomes clear that materiality is by no means a straightforward, immediately intuitive quality. Empirical criteria like impenetrability, tangibility, solidity and dimensionality join subjective ones like authenticity and originality in constituting the meaning and value of a material object. Materiality that is experienced within an analogue environment may share some similarities with the simulated materiality of a digital environment, but there seem to exist a number of characteristics and related concepts which stand in direct, irresolvable opposition to each other. As modelled by some of the critics cited in this chapter, it is imperative to think of the possibilities of digital-bound materiality with an open mind. Further breaking apart the rigid criteria associated with conventional materiality will become useful when evaluating digital reality-constructs that rely on the abstract simulation, approximation and representation of material objects. If the primacy of purely physical, touch-based materiality can be loosened and substituted with a broader sense or feeling that *suggests* materiality, the promise of creating digitally material heritage moves closer into reach.

*3. Synthesising the antagonism: digital materiality*

The previous discussion of materiality has already, at certain points, preempted the argument that will be more deeply and explicitly developed in this chapter: namely that these traditional philosophical frameworks offer both affirmation of and friction against the alternative materiality that is slowly emerging in the digital realm. The following two subchapters will attempt to deconstruct digital materiality into its seemingly contradictory components. The first subchapter will expand on the material inner workings of digital technology, and try to dispense with the erroneous supposition that digital objects are inherently immaterial. The second subchapter will then push back against the materially 'reductionist' frameworks introduced in the first subsection, and carve out a more differentiated understanding of the digital as an ontologically separate entity.

*3.1. Anchoring the digital object in its material foundation*

No discussion on the material foundations that underpin digital technology would be complete without mentioning the seminal groundwork done by Matthew Kirschenbaum in his 2008 monograph *Mechanisms: New Media and the Forensic Imagination*. Kirschenbaum's essential argument revolves around the idea that 'digital media is not only material in the general sense of having a material basis, but also in the specific sense of each object being unique and forensically tractable.'[63] Digital artists and digitisation professionals like the aforementioned Sarah Norris and Douglas Davis seem to hold the conventional belief that digital objects are inherently immaterial, and therefore perfectly and limitlessly multipliable. In the words of previously cited digital humanities scholar Aljayyousi, 'code-based objects tend to behave immaterially, especially at the phenomenological level of the user's experience.'[64] This conception of digital objects as 'pure information, floating somehow in immaterial space'[65] may seem intuitively plausible, but is actually in contradiction with the underlying structure of digital technologies.

Crucially, Matthew Kirschenbaum's book recognises the digital environment's 'illusion... of immaterial behavior: identification without ambiguity, transmission without loss, repetition without originality'[66] and sets out to systematically dismantle this supposition. More concretely, his investigation locates the basic mechanisms which undergird the storage and transmission of

[63] M. I. Aljayyousi, 'Enter the Digital: Emergent Materiality and the Digitization of Literary Texts: The Novel as a Case Study', p. 6.
[64] Ibidem, p. 6-7.
[65] H. Geismar, *Museum Object Lessons for the Digital Age*, p. 18.
[66] M. G. Kirschenbaum, *Mechanisms: New Media and the Forensic Imagination* (Cambridge, Massachusetts: MIT Press, 2012), p. 11.

electronic data and exposes the material traces left behind by virtually every digital process. Kirschenbaum introduces a dual distinction between the forensic and formal materiality of computational content.[67] On the one hand, forensic materiality 'rests upon the potential for individualization inherent in matter'.[68] The fact that digital processes can be retraced, in a literally forensic manner, through a close examination of computer hardware and firmware reveals an undeniable but scarcely visible dimension of materiality to be present in the digital medium. For example, the previous existence of deleted or destroyed files may be proven retroactively through an investigation of the computational wear-and-tear they caused on a micro- and nanoscale, the latter of which Kirschenbaum evocatively refers to as 'the threshold between the material and immaterial'.[69] Formal materiality, by contrast, relates to the structured framework of interaction within which a human user experiences digital data or objects, and is defined by Kirschenbaum as the 'imposition of multiple-relational computational states on a data set or digital object'.[70] Simply put, this kind of materiality relates to the formal presentation of digital objects, and changes depending on which technological device and/or in which 'software environment' the object appears. Since 'the lines between hardware and software are themselves increasingly blurred,'[71] Kirschenbaum's formal materiality concept is not exclusively bound to the device which is used to view the object (be it a smartphone touchscreen, a desktop PC screen, or a VR headset), but is also constituted by the digital interface, software application or file format within which the object is called up. What emerges from Kirschenbaum's highly technical explanations is that no matter how immaterial digital objects may seem, they are only made possible through materially existent mechanisms and building blocks, which may be microscopic, but are nonetheless real. If every digitally executed action can leave its own trace - be it in the form of barely visible silicone damage, or of dust patterns settling on a surface - this is evidence of the 'individualization inherent in matter' against which the digital realm is usually defined. In their 2012 book *Digital Anthropology*, Heather A. Horst and Daniel Miller stipulate that the digital is 'all that which can be ultimately reduced to binary code but which produces a further proliferation of particularity and difference.'[72] For these scholars, every digital object already and necessarily contains within itself the potential for its own differentiation. The existence of unique material traces complicates any idealistic notions around the perfect incorruptibility and indistinguishability of digital content, and

[67] See M. G. Kirschenbaum, *Mechanisms: New Media and the Forensic Imagination,* pp. 9-15.
[68] Ibidem, p. 11.
[69] Ibidem, p. 2.
[70] Ibidem, p. 13.
[71] Ibidem.
[72] H. A. Horst and D. Miller, *Digital Anthropology* (London/New York: Berg, 2012), p. 3.

calls into question the basic antagonism between analogue materiality and digital immateriality outlined in the previous chapter.

While the science around computer chip forensics may not directly impact our experience of VR and AR environments, the idea that a digital product is actually rooted in material reality changes a user's relationship to it. The forensic and formal materialities described by Kirschenbaum open up new avenues for crediting individual objects with radically new, digitally material forms of 'aura'. One might, for instance, recognise the forensic idiosyncrasy of every digitally generated image, while also being more aware of the formal difference between a film that plays on a flatscreen television versus one which plays on a defunct iPod classic. For projects like CyArk and Time Machine, who make it their mission to preserve invaluable cultural heritage, it becomes all the more important to realise that every digital object is essentially an irreproducible original in its own right, and that the process of digitally rendering a physical original only ever creates other, slightly different originals. Not only is Berlin's Brandenburg Gate not the same as the one shown on CyArk, but the CyArk Brandenburg shown today on one computer is, materially, not the same as one called up on another device tomorrow, or even as one shown at the same time via a different software or operating system. Grasping materiality at this level should also alert digital heritage preservation projects to the danger of possibly damaging or losing their digital files. In order for future generations to make use of the preserved materials, established protocols need to be followed, requiring multiple copies to be saved at secure locations, file formats to be updated periodically, databases and metadata to be maintained, and software interoperability between different systems, programmes and protocols to be guaranteed.

Considering all of the material mechanisms involved in its production and usage, it becomes clear that the digital file is anchored into an entirely material context. Now more than ever, it becomes important to realise that digital objects are implicated in real-world processes and have become crucial instruments for politics, the economy and finance to exercise control and generate profits. The grave conditions under which cobalt is mined to produce smartphones are only one example which illustrates the dark underbelly of the increasing demand for digital technology in all areas of life.[73] Its negative externalities cannot simply be stored away in a 'cloud', but are swiftly reabsorbed into a global digital ecosystem, in which resources are already contested, people are exploited, and the environment is at risk. A materialist conception of digital technology must reckon with the very long and very real chain of labour, raw materials, infrastructural provisions

[73] S. Kara, 'Is your phone tainted by the misery of the 35,000 children in Congo's mines?', in: *The Guardian*, 12 October 2018 <https://www.theguardian.com/global-development/2018/oct/12/phone-misery-children-congo-cobalt-mines-drc> (7 July 2020).

and energy sources which are necessarily involved in the production, dissemination and maintenance of digital resources. Moreover, private data is often unwittingly produced and given away by users, only to be stored and sold off by corporations. At this stage, data reveals itself to be not just an ethereal piece of information, but as a commodity in its own right, subject to a highly financialised, data-driven form of capitalism. Along the lines of an argument already developed by critics like Baruch Gottlieb in *Digital Materialism: Origins, Philosophies, Prospects* or Shoshana Zuboff in *The Age of Surveillance Capitalism,* the digital space is not and has never been a politically or economically neutralised space, in which human users can conveniently transcend the messy reality of their material circumstances. Puncturing the illusion of digital immateriality and technically deconstructing digital technology to its material basics is a vital step in fostering greater political consciousness. In realising the materiality of their digital products, cultural heritage projects are better prepared to recognise their role in the global digitalisation of human economy, society and culture, and all of the physically manifest consequences which stem from it.

At this point, it may be appropriate to shift gears and to view the significance of Kirschenbaum's insights from a slightly different perspective. In her philosophical rumination on the question 'What is a digital object?', Yuk Hui considers the kind of materialism practiced by scholars like Matthew Kirschenbaum to feel somewhat unsatisfactory. In her argument, Hui descends down ever-decreasing scales of analysis, going from the level of binary code which supports text files, to the level of circuit boards, at which only 'signals generated by the values of voltage and the operation of logic gates'[74] exist. In what reads almost like a provocation to the digital materialists, Hui then asks:

> 'How, then, can we think about the voltage differences as being the substance of a digital object? Searching downward we may end up with the mediation of silicon and metal. And finally we could go into particles and fields. But this kind of reductionism doesn't tell us much about the world.'[75]

While the term 'reductionism' may be a rather harsh way of framing the materialist dismantling of digital technology's nuts and bolts, it does strike at the heart of a pertinent question: how do the material rudimentals which constitute digital objects actually inflect our experience of them as objects, especially when those objects hold cultural and symbolic meaning? Perhaps, digital cultural objects become material, not on the basis of their metal and plastic parts, but on the grounds that

[74] Y. Hui, 'What Is a Digital Object?', in: *Metaphilosophy* 43, 4 (2012), p. 387.
[75] Ibidem.

human perception and intelligence can interpret them as such. Digital materiality, then, cannot be understood within the confines of a purely empirical or technical discussion. Instead, it should be seen as the result of an interpretative process, out of which materiality emerges as a phenomenological occurrence.

In one of the articles of *A New Companion to Digital Humanities*, Sydney J. Shep echoes this expanded and subjectivised conception of materiality, showing that for a large group of digital humanities scholars, 'materiality only exists in acts of perception, in performance, in use, in practice.'[76] One such scholar is N. Katherine Hayles, who advocates, in Shep's words, for the 'necessary decoupling of physicality from materiality'[77] in her 2012 monograph *How We Think: Digital Media and Contemporary Technogenesis*. For Shep, Hayles describes physicality as 'an ontologically discrete entity', while materiality is defined as 'an emergent property that comes into existence through an act of engagement or, as she terms in, "attention" which identifies and isolates one or more specific, physical attributes...'[78] This dovetails nicely with an earlier discussion on the digital tactic of synesthetically substituting certain physical attributes of material objects, such as their tangibility, through a visual approximation that compellingly *suggests* these attributes. A digital object which successfully redirects our attention towards those aspects of itself which persuasively simulate, visually or otherwise, its three-dimensionality, can qualify as effectively material, despite its ontological non-physicality. This broader re-interpretation of materiality, which allows for it to exist as a subjectively perceived phenomenon, essentially culminates in a *phenomenological materiality*, which emerges out of the interaction between a digital object and the human subjectivity interpreting it.

In her book *Writing Machines*, N. Katherine Hayles fittingly states that 'materiality emerges from the dynamic interplay between the richness of a physically robust world and human intelligence', the latter of which 'crafts physicality' by cross-referencing the simulated object with former memories of physicality proper.[79] Eminent digital studies scholar Johanna Drucker follows this up in a similar fashion, succinctly proposing that

> '...the concept of materiality is understood as a process of interpretation rather than a positing of the characteristics of an object. The object, as such, exists only in relation to the

[76] S. J. Shep, 'Digital Materiality', in: *A New Companion to Digital Humanities*, ed. S. Schreibman, R. Siemens and J. Unsworth (2016), p. 389.
[77] Ibidem.
[78] Ibidem. Here, Shep indirectly quotes N. K. Hayles, *How We Think: Digital Media and Contemporary Technogenesis* (Chicago: University of Chicago Press, 2012), p. 91.
[79] N. K. Hayles, *Writing Machines* (Cambridge, Massachusetts: MIT Press, 2002), p. 33.

activity of interpretation and is therefore granted its characteristic forms only as part of that activity...'[80]

The emphasis on digital materiality as the product of an interpretive process allows for it to be understood as dynamic and ever-developing, constantly negotiating its position between the abstract and the material. In fact, Haidy Geismar cites Sarah Pink et al. to suggest that digital materiality ought to be conceptualised as an '"an unfolding process", not simply as an end product or a finished object.'[81] For Geismar, the materiality of digital objects is 'in fact continually shifting,'[82] meaning that it is constantly in flux and motion, not just within subjective interpretation, but also on the forensic level of Kirschenbaum's conceptions. For Geismar and other modern scholars, digital materiality emerges at every moment from the precise and synchronised movements of radio waves and electrical currents travelling through air, hardware and circuits.[83] The observations assembled here show that materiality can find a variety of expressions within a digital environment: it can be detected both on a purely *formal* or *forensic* level, as well as on a *phenomenological* or *interpretive* one. What all of these different iterations of digital materiality have in common is that in order for them to come into being, they rely on a range of highly dynamic processes, occurring within the circuitry of a computer processor, within the synaptic network of an individual brain, and within the greater systems of meaning that pulsates through our cultures and societies.

### *3.2. Elevating the digital object through the principle of abstraction*

After outlining the ways in which the material shapes the digital, it is now time to consider more closely how, conversely, the digital has also managed to defy and distinguish itself from the material. This subchapter will survey the conflict between the digital materialists and the digital abstractionists, as well as explain the descriptive value of the onion model of reality.

Despite its well-argued position, materialist 'reductionism' does not account for the unshakeable impression that the digital medium is meaningfully distinct from its material foundation, and that it abides by different rules. From electric signals, binary codes and algorithmic determinations emerge miraculous vistas of alternative reality, accessible through interactive

[80] J. Drucker, *The Visible Word: Experimental Typography and Modern Art*, 1909-1923 (Chicago: University of Chicago Press, 1994), 42.
[81] H. Geismar, *Museum Object Lessons for the Digital Age*, p. 18. Here, Geismar quotes S. Pink, E. Ardèvol and D. Lanzeni, *Digital Materialities: Design and Anthropology* (London, New York: Bloomsbury Academic, 2016), p. 10.
[82] H. Geismar, *Museum Object Lessons for the Digital Age*, p. 18.
[83] Ibidem.

interfaces that allow for numerical, textual and sensory information to be displayed, transmitted and stored almost instantaneously. Aden Evens' evocative comments on the unique ontology of the digital medium push back on any understanding of digitality through the definitive and potentially reductive paradigm of materiality. While '[m]ateriality is indispensable,' Evens writes, 'it haunts the digital, but the digital's distinction, its particular way of being, derives from its erosion of materiality, its embrace of the abstract.'[84] In the face of the findings outlined in the previous chapter, materiality can, of course, never be entirely disregarded when trying to discern the characteristics of digital reality. Nonetheless, one also has to admit that the digital object is infused with a novel experiential quality that is intuitively distinct from the conventional existence of physical objects. The idea that digitality subverts, or to use Evens' terminology, 'erodes' materiality may also result from the competitive relationship into which digital and physical experiences have already begun to enter into. To give a practical example, as technologies develop towards higher levels of accessibility and sophistication, a family might opt for a virtual exploration of the Brandenburg Gate via CyArk, as opposed to booking a trip to Berlin. As digital technology refines its simulation of materiality, the material original will likely lose its economic value, before it relinquishes its auratic one.

If, then, a solely materialist conception of the digital realm is not enough to fully grasp it, what other structuring concept could serve as its ontological foundation? For Evens, it is digital technology's 'embrace of the abstract', as opposed to its material foundation, which functions as the central organising principle of the digital:

> 'Abstraction universalizes the operations of the digital, allowing it to capture and manipulate with the same basic tool any information, images, sounds, words, patterns, and more; whatever has a structure, whatever is information is amenable to digital representation.'[85]

If a digital object can only exist through representation in a computational system, then it needs to comply with the structural and definitional conditions that govern this system and all of its components. To become manifest in the digital space, an 'object' needs to be *abstracted* into a unit of information first, and then be made to fit into a pre-existing hierarchical structure of other abstractions. The rules and laws that govern it are primarily those of computational code and mathematics, not Newtonian physics. Digital technology radically challenges the notion that to be

[84] A. Evens, 'Web 2.0 and the Ontology of the Digital', in: *Digital Humanities Quarterly* 6, 2 (2012) <http://www.digitalhumanities.org//dhq/vol/6/2/000120/000120.html> (27 May 2020), 14.
[85] Ibidem, 3.

real, something has to also be entirely made up of matter. It seems that for Evens, many potentially interesting discussions would fall by the wayside if this finer distinction was swept under the rug, purely for the sake of uniformising the digital and material under a materialist umbrella ontology. The digital 'erosion of materiality, its embrace of the abstract', as Evens so luminously phrases it, invites us to disentangle our sense of reality from conventional materiality. He encourages us to view abstraction as the decisive feature from which the distinctive ambience of the virtual realm results:

> 'It is its immateriality, or rather its abstraction-made-material that distinguishes the digital from other media… The digital is born through an intensification of abstraction, and this principle of abstraction empowers the digital precisely by pushing against its material affiliation.'[86]

In this formulation, Evens clarifies that to understand digital processes as arising from purely material ones is to miss the significant role played by the principle of abstraction. In this context, abstraction designates a qualitatively significant conversion of the material object into a sequence of code. Analogue or mechanical reproductions allow the original to remain within its familiar domain of materiality, continuing in minimally different colours, textures or proportions. Digital reproductions, on the other hand, necessitate the existential reworking of an original object into a set of computational instructions. As Chris Chesher writes in his article *The Ontology of Digital Domains*: 'Where analogue involves a conversion of form, digital always involves encoding and decoding...'[87] In full agreement with the ontologically transformative effect of digitisation, Amsterdam-based researcher André Nusselder helpfully summarises the distinction further:

> 'Digital representation breaks with the principles of continuity, proportionality, and similarity that characterize analogy. The similarity of form between object and representation is no longer the basis of its encoding, but a translation of the object into numbers of a binary language.'[88]

[86] A. Evens, 'Web 2.0 and the Ontology of the Digital', 14.
[87] C. Chesher, 'The Ontology of Digital Domains', in: *Virtual Politics: Identity and Community in Cyberspace*, ed. D. Holmes (London: Sage, 1997), p. 86.
[88] A. Nusselder, *Interface Fantasy: A Lacanian Cyborg Ontology* (Cambridge, Massachusetts: MIT Press, 2009), p. 48.

Nusselder sees digitisation as 'confront[ing] us with the notion of a radical break with the principle of analogy as a "conversion of form,"' as well as 'break[ing] loose from the *identity of form*', whereby 'form' can be taken to mean material substance.[89] In defiance of the material reductionists, scholars like Evens and Nusselder highlight that the principle of abstraction is not simply an interesting quirk of digital technology. In fact, abstraction acts as the key point of distinction between material and digital ontologies. Whereas Kirschenbaumian theorists would argue that within digital technology, the material gives rise to abstractions, Evens conversely posits that, in fact, it is abstraction which is made material within the digital framework.

One specific way in which the digital medium's abstractive nature reveals itself to be ontologically distinct is that 'it isn't very particular about materials' and can therefore be 'spread so widely, accommodat[ing] in its universal code so many diverse data, infiltrate so many areas of human endeavor.'[90] Here, Evens refers to digital code as being uniquely indiscriminate of the material through which it can be transmitted and displayed. Naturally, there are certain material substances and arrangements needed in order for digital code to be processed, but the sheer variety of different hardware configurations, devices, programmes and operating systems affirms that digital code does not operate in strict adherence to material particularity. Rather, its abstractive structure allows for digital objects to instantiate themselves more or less freely across time and space, via an ever-increasing variety of hardware and software. On the basis of its abstractive nature, the digital can therefore be said to exist in an exceptional state of separation from any specific materiality. What was previously designated as *formal materiality* by Kirschenbaum, i.e. the diversity of material conditions in which the digital can appear, Evens actually sees as a further indication of the digital's revolutionary *immateriality*. It follows that for Evens, abstraction is the quintessential characteristic of digitality, the critical point of departure at which the digital splits off from the ontological paradigm of the material, and ventures into its own. Hence, it cannot simply and seamlessly be absorbed by the same theoretical framework that is applied to conventional materiality.

As previously outlined, some commentators have exalted the digital as a realm of absolute Platonic Form, of perfect multiplication and non-degradation. Evens, by contrast, points out that it is precisely because of their abstract nature that digital objects are actually *more* susceptible to alteration, mutation and transformation. It is in its abstraction-based ontology that Evens locates the reason for the digital object's vast mutability potential:

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[89] A. Nusselder, *Interface Fantasy: A Lacanian Cyborg Ontology,* 8.
[90] A. Evens, 'Web 2.0 and the Ontology of the Digital', 14.

> ‘Only because of its thoroughgoing abstraction does the digital allow such easy manipulation of virtual objects, objects which, should they exist in the actual, might be quite resistant to alteration or difficult to access.’[91]

Whereas only time and active force could modify a physical monument, a digital reconstruction can be changed or even destroyed and rendered useless though a minor change in a sequence of code, a press of a button, a click of a mouse. What underlies this argument is that the digital object, as it exists in abstract, dematerialised space, is endowed with a heightened quality of vulnerability, fragility and mutability. The digital susceptibility to manipulation contrasts with what Haidy Geismar called the ‘heavy stasis of the museum artefact’[92] whose comparative stability across time and space may be undermined through the transformative process of digitisation.

From the noticeable distinction between the digital and material emerge new possibilities, especially when digitising art objects and other forms of cultural heritage. In her book *SpecLab: Digital Aesthetics and Projects in Speculative Computing,* eminent digital humanities scholar Johanna Drucker advocates for a concerted effort to seize and make use of these possibilities: a new aesthetic needs to be developed for the digitisation of cultural and artistic objects, an aesthetic which takes seriously the task of transcending the constraints of original material forms and explores the unique abstractive qualities of the digital medium. Referring to the digitisation of books, for example, Drucker comments that rendering books ‘in electronic space [...] is based on the false premise that they function as well in simulacral form as in their familiar physical instantiation’.[93] Ebooks which emulate the turning of a page, both through visual or audio effects, do not qualify as convincing digitisations of literary material. In Drucker’s view, an ebook that contains turnable ‘pages’ represents a cultural object which was digitised in a way that only re-imposes onto it the all-too-familiar characteristics of its initial physical form. Rather ironically, such purely emulative methods of digitisation often fail to invoke the lost materiality of the original, only emphasising this loss through unsuccessful mimicry. Even more important is that an uncritical adherence to the materiality of the original format comes at the cost of discovering a new aesthetic for what is supposed to be its digital reinvention.

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[91] A. Evens, ‘Web 2.0 and the Ontology of the Digital’, 14.
[92] H. Geismar, *Museum Object Lessons for the Digital Age*, p. xviii.
[93] J. Drucker, *SpecLab: Digital Aesthetics and Projects in Speculative Computing* (Chicago: The University of Chicago Press, 2009), p. 173.

Convinced that digital objects do indeed offer an experience that is distinct from their original material format, Mohammad Ibrahim Aljayyousi launched the iNovel project. Much like Drucker, Aljayyousi worked from the perspective that 'simulating the page digitally is based on a misconception that form is ideal and can be abstracted from its material condition, thus a paper can be modeled on screen.'[94] Consequently, Aljayyousi developed an application which removes the novel from its conventional, page-bound codicological format and tries to find an alternative form which makes fully effective use of its digital environment. This includes restructuring the novel, visualising particular character arcs, and allowing for interactive note-taking functions. The project exemplifies the digital ability to abstract and isolate the essential ideas, traits and patterns within a material object and to reorganise them in a more effective way. Despite such applications undoubtedly proving useful to students, it cannot be denied that the artistic object and our experience of it is fundamentally altered by the liberties of the digital medium. Aljayyousi himself admits that the '[m]igration of texts, which remains a necessity, is better thought of as a process of translation with a certain amount of loss and gain.'[95] The imperfect process of translation seems to be an inevitable part of every digitisation project, but should not be held up as a deterrent against digitisation in general. A simple and perfectly equivalent transference of an object from a material to a digital state is, after all, neither possible nor desirable. The fact that the digital not only enables but actually *demands* new parameters for the presentation of cultural goods seems to indicate that it operates through experiential and structural principles that are fundamentally distinct from those of material objects.

The digital, then, is not simply a new mechanic which can be smoothly integrated into the material world, but must also be understood as a separate, if inextricably connected, ontological paradigm. To this point, it may be informative to consult the *onion model of reality*, or OMR, as an apt visualisation for the relationship between interconnected digital and material ontologies. The onion model of reality, as the name suggests, conceives of reality in its totality as a composite entity, in which

> '...higher realities envelop all the preceding layers as well as ultimate reality. Although one layer emerges out of the preceding ones and can be traced to them, this does not imply that any such layers or its entities can be 'reduced' to a preceding layer...'[96]

[94] M. I. Aljayyousi, 'Enter the Digital: Emergent Materiality and the Digitization of Literary Texts: The Novel as a Case Study', p. 15.
[95] Ibidem, p. 20.
[96] R. Mattessich, 'Accounting Representation and the Onion Model of Reality: A Comparison with Baudrillard's Orders of Simulacra and His Hyperreality', in: *Accounting Organizations and Society* 28, 5 (2003), p. 448.

In the context of accounting studies, in which an economist like Richard Mattessich operates, one might view the domain of finances as emerging from an industrial manufacturing economy, which in turn emerged from an agricultural model of production. Each economic arena builds on top of the other, integrating some of the rules and principles inherent to the former arena, while introducing new functions and practices, and expanding the scope and reach of their operations. In a similar way, virtual reality could be seen as the outer layer of the 'onion', encasing the lower layer of material reality with a slightly more evolved set of ontological characteristics. OMR is heavily informed by the Argentine philosopher Mario Augusts Bunge's theory of emergentism, as opposed to reductionism, in understanding the dynamic systems that constitute human reality.[97] In this framework, reductionist thinking would be exhibited by overzealous materialists, all too quick to collapse newly emerging ontologies into the securely established one of physical materiality. The conclusion facilitated by the onion model, however, is that digitality can be understood as an emergent higher layer within the universal 'onion', a layer which both envelopes and further develops the basic material layer out of which it has grown.

To varying extents, this onion model of reality may be applied to virtual cultural heritage objects and their relationship with the physical structures on which they are based. A virtual reality project like CyArk, for instance, creates a replica of a material monument within the architecture of cyberspace. Through a functional device and an internet connection, the virtually duplicated space can be accessed from anywhere - a user does not have to be physically present at the site's location for them to enter into its virtual counterpart. Thus, a CyArk monument may be sourced from a real object and location, but ultimately exists in dislocated separation from it. Recalling the image of the outer layer of an onion, it is also more spatially expansive than its lower layers, in that it covers a greater surface area. Fittingly, the virtual rendering of the heritage site not only 'contains' a 3D surface model of it, but also enriches it with a bulk of informational 'excess'. The digital rendering effectively 'enlarges' the representation by attaching additional contextualising elements to it, and by embedding the virtual monument into an even greater web of data through the use of hyperlinks. Going one step further, one could speculate on what the increasing popularity of 3D printing would mean for the 'onion' model, as applied to CyArk. One could easily envision digital heritage projects making smaller-scale monuments available to be 3D-printed by private users. This could signify a partial collapse of the digital stratum back into its material foundation, and facilitate an interesting

[97] M. Bunge, *Treatise on basic philosophy, Vol. 6—Epistemology and methodology II: understanding the world* (Dordrecht, Holland: D. Reidel Publishing, 1983), pp. 40-41.

backwards loop: the digital model is rematerialised and returned to the physical paradigm from which it originated.

An augmented reality project like the Bamiyan Buddha, on the other hand, may not be quite as suitably understood through the onion model, as the holographic Buddha simply serves to fill an already existing void, and neither seeks to duplicate an already materially available object, nor 'enlarge' it with added information or digital functions. In a similar way, the virtual cityscapes and interiors created by Rome Reborn or Time Machine attempt to resurrect a historical reality whose material instantiation has long been lost. The virtual outer layer is built, so to speak, around a material centre that is mainly hollow, only partially reconstructed from incomplete remnants, pieced together from archeological sites, archives and museums. The emergent virtual reproduction can therefore only be as whole as the often incomplete patchwork of material clues on which it is based. Damages to the core of the onion, it seems, will inevitably show at its outer surface. The onion model is therefore most satisfying when applied to a situation in which the material layer is still intact enough to grow a robust digital replica on top of itself.

While the 'onion reality' may seem like an evocative metaphor, its application does not come without its fair share of problems. Firstly, the onion model still requires a figurative splitting of the material and digital into adjacent but separate layers, with the boundary between the two remaining clearly delineated. An onion's segmented structure does not adequately convey the high interactivity and interdependency that characterise digital and material spaces in the real world. Secondly, the onion model imposes a divided hierarchy, in which the material realm provides the soil from which the digital is grown. Here, the power of influence runs unilaterally, directed from the lower layers toward the higher ones, and does not explicitly allow for the digital realm to impact or shape the material one. Finally, one could criticise that the onion model does not offer any insight into what the ontological and phenomenological differences between the digital and material actually are. As a metaphor, OMR may illustrate how the two structures relate to each other, but does not provide a qualitative analysis or interpretation of their distinguishing features.

Nonetheless, Mattessich observes that the higher layers of the OMR tend to be 'more changeable or volatile than the more basic layers.'[98] In fact, he claims that '[i]ndeed, the higher we climb the hierarchy, the more we see new realities emerge.'[99] The dynamics at play seem to suggest that new ontological levels will eventually emerge out of the digital layer. As digital structures are exponentially enriched with mounting layers of information and data, these additional levels may

[98] R. Mattessich, 'Accounting Representation and the Onion Model of Reality: A Comparison with Baudrillard's Orders of Simulacra and His Hyperreality', p. 454.
[99] Ibidem.

gradually take on a distinct ontological system of their own. Just as materiality birthed digitality, so could digitality spawn its own supra-structure, governed by yet another set of distinct organisational and experiential principles. It is also conceivable that the many shortcomings of the digital emulation of materiality will only be resolved at a later stage, somewhere in a future stratum that has yet to emerge from the onion. Perhaps, it is only at a more advanced stage of ontological evolution that digital materiality could arrive at its fully depolarised and synthesised pinnacle.

The project of reconciling the dualism of digital materiality is wrought with ontological tensions, and the more one tries to pin it down, the more dynamic, complicated and layered the concept seems to become. So far, we have seen how digital representations of material objects are inherently and inevitably constituted by the material circumstances from which they arise. Acknowledging the material foundations of digital objects can help legitimise digitisation projects in their efforts to reconstruct artifacts: digitisation must not equal a flat visual reconstruction on a screen, but can allow for an alternative expression of an object's essential qualities and auratic value. While the digital medium certainly depends on materiality at this level, it is also characterised by a deeply abstractive, dematerialised structure. Much like Aden Evens, digital scholar Richard Kedzior aptly proposes that digital materiality is produced by abstract, 'intangible representations and simulations' which are then 'materially mediated through [...] computer screens' or other technical devices.[100] In contrast to previous, more enthusiastically materialistic chapters, this subchapter has sought to understand abstraction as the digital medium's distinctive ontological feature, which meaningfully separates digitally simulated materiality from materiality proper. The argument has been careful not to collapse the digital back into the material completely, and instead tried to acknowledge the ontological separation between the digital and the material, in part through the use of the onion model. Ontological models like OMR conceive of digitality as emergent from materiality, and as incorporating characteristics of physical materiality, either by way of its own material components or through the aesthetic emulation of conventionally material qualities. On top of this, digital systems bring new experiential possibilities to the table, by abstracting from a material object its most significant aspects, and embedding it within a new ontology. Through the process of informational enrichment, contextual embedding and multimedial enhancement, the materiality of a monument is not merely emulated, but transcended. Despite their continued reliance on material mediation, it can be argued that digital spaces have already broken

[100] R. Kedzior, *How Digital Worlds Become Material*, PhD Thesis (Helsinki, Finland: Hanken School of Economics, 2014), p. 7.

away from the familiar ontology that governs the analogue. By now, the abstract forces of data and code have begun to absorb material objects into new architectures of meaning.

### *4. Theorising the simulacrum: 'the reality of the virtual'*

As briefly mentioned before, one of the great shortcomings of the OMR is that it frames the material as the basic layer which engenders and supports the digital, but does not in any way visualise the reverse relationship. It does not account for how the frequent navigation of digital spaces is already influencing our experience and conceptualisation of material ones. This chapter will bring this exploration of digital materiality to a close by looking into the arguments behind, as well as the critical reactions against simulacrum theory, most notably developed in *Simulacra and Simulation*, written by French philosopher Jean Baudrillard in 1981. Arguably, digital technology has destabilised the certainty and singular authority of the material world, connecting its users to the plurality of alternate realities that are emerging in the virtual. In addition, this chapter will look into how digital materiality relies on immersivity, which is created when digital structures enmesh themselves within human neurological systems and may reinforce what cognitive philosophy researcher Andy Clark calls the 'extended mind'.[101]

#### *4.1. Multiplying the Real: virtuality and its relativisation of the material*

In his typically provocative manner, Slovenian philosopher Slavoj Žižek frames virtual reality as 'a rather miserable idea', that is to say a fundamentally unimaginative one: 'it simply means 'let us reproduce in an artificial digital medium our experience of reality.' What strikes the popular Hegelian as far more interesting is 'not virtual reality' in its purely emulative mode, 'but the reality of the virtual'.[102] What does he mean by this? In his 1996 article *From Virtual Reality to the Virtualization of Reality*, the 2004 documentary film *Manufacturing Reality: Slavoj Žižek and the Reality of the Virtual* as well as his 2012 book *Organs without Bodies*, Žižek suggests, albeit rather cryptically, that virtual media provide possible conduits to the Real, a concept most prominently

[101] A. Clark, 'Natural Born Cyborgs?', in: *Edge*, 28 December 2000 <https://www.edge.org/conversation/natural-born-cyborgs> (02 March 2020).
[102] B. Wright and S. Žižek, *Manufacturing Reality: Slavoj Žižek and the Reality of the Virtual*, Documentary film (London: Ben Wright Film Productions, 2004) <https://www.youtube.com/watch?v=RnTQhIRcrno> (02 March 2020)., quotes from 0:30-1:01.

associated with the French psychoanalytic theorist Jacques Lacan.[103] In the psychoanalytic context, the Real is used to conceptualise an unspeakable trauma, which can never be fully articulated or even remembered, but which still directs the psyche powerfully and indefinitely. More generally, the Real can be understood as the field of authentic, undistorted truth, one that lies beyond the horizon of human perception or reasoning, but one that nonetheless permeates the human experience of 'lowercase reality' with resonant meaning. When looking at the Real, it may also be worth recalling the aforecited Immanuel Kant, who theorised that 'we can know only phenomena', i.e. the perceivable contours of a thing.[104] The actual noumenon, or, as Kant calls it, 'the thing-in-itself' [*das Ding an sich*] is forever unknowable, remaining hidden behind perceivable appearances or phenomena.[105] To briefly return to the OMR visualisation, the Real might be represented by what biologists would call the 'tunic' of the onion. This is the hard papery sheet that encompasses and contains the soft flesh of the bulb, but which itself remains qualitatively and functionally separate from the edible rest.

The Real is relevant for digitisation practices because its noumenality critically subverts and relativises the primacy of material reality. It suggests that even in its ordinary material state, an object is only partially represented, and that there are semantic or sensory dimensions to it which still lie submerged in the noumenal Real. The conversion of material statues, monuments or paintings into a digital format may serve as a way to unearth more of this hidden dimension, and to lay bare these previously unknowable qualities. Presumably, this could be achieved by recontextualising heritage objects within digital structures that allow users to, for instance, exhibit the objects in a personalised virtual showroom, rearrange their components, change their proportions or colour saturations, compliment them with informative or poetic texts, or even play music to accompany the experience. Such digital functionalities could excavate hidden meanings and effects, and provoke inarticulable emotions or insights, traces of the Real. Digitisation may be yet another attempt of human consciousness to get at 'the thing-in-itself' from a new angle, to pierce through the curtain into the dimension of the Real. The *reality* of the virtual, then, is grounded in the partial, experiential, and phenomenological access it grants to the Real.

Unfortunately, highly customisable virtual heritage spaces such as the one envisioned above are still a rarity, with only a few platforms allowing users to create their own virtual exhibitions. Amsterdam's Rijksmusem, for instance, enables online visitors to compose their own galleries via

[103] See Section 2. 1. 3 in: A. Johnston, 'Jacques Lacan', in: *The Stanford Encyclopedia of Philosophy* (Fall 2018 edition), ed. Edward N. Zalta, 10 July 2018 <https://plato.stanford.edu/archives/fall2018/entries/lacan/> (30 June 2020).
[104] R. Mattessich, 'Accounting Representation and the Onion Model of Reality: A Comparison with Baudrillard's Orders of Simulacra and His Hyperreality', p. 445.
[105] Ibidem, p. 454.

the so-called *Rijksstudio* application.[106] These galleries however, do not extend far beyond two-dimensional inventories of personal favourites, which can be shared with other users on the website. Given the technological possibilities, it should soon be relatively standard practice for institutions to provide more of these customisable design spaces, in which users can create personalised exhibitions in a three-dimensional, multimodal and freely combinatory way. One can only imagine what shifting the authoritative power of exhibition design from institutions to digital consumers would mean for both these institutions, their clientele and the cultural sector at large. Digitising material objects through advanced 3D imaging and synesthetic trickery would only be the first step in this endeavour. Tapping into linked open data networks and API technologies would also need to be on the agenda, so that a global user base could access the resources of different digital heritage institutions and recombine them into creatively interconnected and recontextualised cultural landscapes. To harness their full potential, digitised heritage collections would need to be integrated into large networks and multi-layered ontologies, reflecting, in some sense, the vast, transcendent territory of the Real.

In their sheerly infinite modifiability and reproducibility, digital spaces correspond with the unfathomable plurality that characterises the Real. By accessing the virtual, humans can partake in a diversified and multinodal experience that lies beyond the singularity of their individual subjectivity, and connect with a networked web of other experiences. Žižek therefore quite aptly likens the virtual to a space which transcends material reality in that it 'is infinitely RICHER than reality —it is the infinite potential field of virtualities out of which reality is actualized.'[107] This way of synonymising virtuality with potentiality, and conversely, materiality with actuality, reframes digital technologies as tools for entering a multitude of alternate realities. With the help of digital applications, humans can model potential realities before they implement them, can play and modulate, reverse and fast-forward the simulation, and then plot and predict the best course of action. The point here is that the virtual fosters a deeper awareness of the modularity and multivariance of the material world, and could, on a greater social and political level, re-energise efforts to reinvent and 'reprogramme' entrenched structures. The simple lesson of the virtual is that everything might just as well be different.

When Žižek concludes that '[t]he ultimate lesson of virtual reality is the virtualization of true reality'[108] he strikes at the dialectical, mutually constitutive relationship between the material

[106] Rijksmuseum, 'Rijksstudio' <https://www.rijksmuseum.nl/en/rijksstudio> (30 June 2020).
[107] S. Žižek, *Organs Without Bodies  Deleuze and Consequences* (New York: Routledge, 2012), p. 4.
[108] S. Žižek, 'From Virtual Reality to the Virtualization of Reality', in: *Electronic Culture: Technology and Visual Representation*, ed. Tim Druckrey (New York: Aperture, 1996), p. 295.

and digital. While the material may produce the digital in many ways, the reverse is also true: digital technology is reciprocatively subjecting the material world to its computational logic (one only has to consider the powerful grip that a tech-based financial system has on the 'real' economy). The apparent ease with which virtual and material realms interconnect may stem from the fact that the virtual has, in some sense, always already been part of the material. In 2009, digital media philosopher André Nusselder published his monograph *Interface Fantasy: A Lacanian Cyborg Ontology*, in which he applies a psychoanalytic framework to contemplate life in the digital era. In his book, Nusselder refers frequently to the work of contemporary French cultural theorist Pierre Lévy, who describes digital technology as yet another step in an ongoing anthropological trajectory, in which 'virtualization and humanization are concurrent processes.'[109] From this perspective, 'a dimension of virtuality always permeates human reality', because the human mind has always projected itself into different locations and times, performing a quasi-virtual 'detachment of the here and now'.[110] For Lévy, '[i]magination, memory, knowledge, and religion are the vectors of virtualization that have enabled us to leave this 'there' long before the appearance of computerization and digital networks.'[111] Digital technology can thus be described as an evolved tool for continuing this human tendency towards 'desubstantialization', i.e. the quest for meaning in abstract or immaterial things, driving us since the earliest beginnings of culture and art. Digital realities evolve from mental ones, and are expressions of the cognitive drive to self-project into immaterial, imagined spaces.[112] Accepting Nusselder's and Lévy's assessment of all reality as inevitably structured by virtuality, 'cyberspace seems to be nothing else than a realm of technologically produced fictions.'[113]

Digital technology, just like art and religion, is borne out of human imagination and reasoning, and has considerably enlarged and expanded our perception of reality to extend beyond the limits of the physical body. Nusselder notes how 'in a virtual reality environment, we can stand inside a molecule and observe it from the inside.'[114] There is a sense in which through digital exploration, even the most alien and unfamiliar corners of the material world, be it a single molecule or an entire solar system, can become subject to experience, if only by way of simulation. In performing a digital 'time-space compression'[115] (a concept which the geographer David Harvey

[109] A. Nusselder, *Interface Fantasy: A Lacanian Cyborg Ontology*, p. 38.
[110] Ibidem, p. 39.
[111] P. Lévy, *Becoming Virtual: Reality in the Digital Age*, trans. R. Bononno (New York: Plenum Trade, 1998), p. 28.
[112] A. Nusselder, *Interface Fantasy: A Lacanian Cyborg Ontology*, p. 39.
[113] Ibidem, p. 53.
[114] Ibidem.
[115] See D. Harvey, *The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change* (Cambridge, MA: Blackwell, 1990).

uses to describe an effect of global capitalism), digital advancements greatly transform our sense of experiential access to physical spaces, whether they be microscopic cells within the brain, a supernova in a distant galaxy, or a conference room in Tokyo. According to Nusselder, the wide use of remote 'telepresence systems' is a symptom of this transcendent expansion into material space, allowing people to see each other through the 'distant eyes'[116] given to them by digital technology. Virtuality facilitates the encroachment of human subjectivity into ever-increasing portions of the physical universe. The material world becomes traversable and experiencable at practically any scale and scope. In the face of an all-encompassing technology which trades in abstraction and calculation, the material world is literally 'shrinking' through perceptual compression. Competing with the infinitely modifiable multitude of digital environments, the material world can no longer lay claim to providing the only and ultimate access to the Real.

*4. 2. Optimising reality: simulation and remediation*

When thinking about digital simulations and their impact on the physical world, one cannot go with involving the great simulation theorist Jean Baudrillard, from whose writing this thesis has borrowed its title. Baudrillard himself quotes Ecclesiastes' line '[t]he simulacrum is never that which conceals the truth--it is the truth which conceals that there is none', to which he took the liberty of adding: 'The simulacrum is true.'[117] Baudrillard's addition reformulates Ecclesiastes' enigmatic statement into a succinct oxymoron. As expected from a French postmodernist in the late 20th century, Baudrillard's larger theory of the simulacrum works on the basis of a categorical denial of objective truth. Taking this idea to its radical conclusion, Baudrillard asserts that the absence of objectivity in the digital multitude strips any and every material original from its status of supreme authenticity and uniqueness. In this sense, Baudrillard is somewhat of an anti-Benjamin, refusing to acknowledge the significance of aura or even the existence of an original. Baudrillard's contribution to the discussion is that he situates every object - be it material or digital - in a chain of simulatory processes, which are so convoluted and pervasive that tracking down an original is at best a tedious endeavour, and at worst an erroneous one. In *Simulacra and Simulation*, Baudrillard argues that 'the age of simulation thus begins with a liquidation of all referentials' which results in the 'substituting signs of the real for the real itself' through the activities of the 'programmatic,

[116] A. Nusselder, *Interface Fantasy: A Lacanian Cyborg Ontology*, p. 53.
[117] J. Baudrillard, 'Simulacra and Simulations', in: *Selected Writings*, ed. M. Poster (Stanford: Stanford University Press, 2001), p. 169.

perfect descriptive machine' that is the computer.[118] Digital technology vastly accelerates the creation of a multitude of simulations, which rise to such great cultural and psychological prominence that, according to Baudrillard, they ultimately replace and annihilate the original:

> 'Abstraction today is no longer that of the map, the double, the mirror or the concept. Simulation [...] is the generation by models of a real without origin or reality: a hyperreal. [...] Henceforth, it is the map that precedes the territory - precession of simulacra - it is the map that engenders the territory...'[119]

Here, the abstracted model is unmoored from its origin, and comes to anachronistically 'precede' it. The so-called hyperreal may, for example, be at work in historical video games, whose players reenact historical events without knowing anything about them outside of the context of the game. Scholars like Macintosh et al. interpret the hyperreal as 'the current condition of postmodernity where simulacra are no longer associated with any real referent and where signs, images and models circulate...'[120] Finding itself surrounded by free-floating simulations, copies, and faux-originals, humanity senses what Baudrillard calls an overwhelming 'terror of illusion' at the never-ending production of simulacra. In a paradoxical maneuver 'to escape from this total illusion', humans pursue simulation as a strategy of 'realising' the world, 'through science and technology.'[121] In Baudrillard's cryptic conception, technological simulations are created in an attempt to combat the confusing chaos of illusory reality. He theorises that technological simulations are meant to rectify the untruths running rampant in reality proper. Baudrillard's adage 'the simulacrum is true' spells out a complete re-evaluation and inversion of the antagonism between reality and simulation, and by extension, between materiality and digitality. In the 1980s, Baudrillard witnessed the early beginnings of virtual objects and spaces, and radically called into question the social, cultural and phenomenological authority of reality itself, predicting that simulation will be the paradigm to replace it. As Baudrillard puts it: '...the whole system becomes weightless; it is no longer anything but a gigantic simulacrum: not unreal, but a simulacrum.'[122] The simulacrum is true, and is part of the Real, not because it perfectly imitates materiality, but because it transcends materiality. To the virtual cultural heritage sector, Baudrillard's simulacrum theory suggests that rather than merely

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[118] J. Baudrillard, 'Simulacra and Simulations', p. 170.
[119] Ibidem, p. 169.
[120] N. B. Macintosh, T. Shaerer, D.B. Thornton and M. Welker, 'Accounting as Simulacrum and Hyperreality: Perspectives on Income and Capital', in: *Accounting, Organizations and Society* 25 (2000), p. 14.
[121] M. Gane (ed.), *Baudrillard Live: Selected Interviews* (London/New York: Routledge, 2002), p. 184.
[122] J. Baudrillard, 'Simulacra and Simulations', p. 173.

emulating and enhancing a material object, an effective digitisation would have to render the original obsolete.

In *Remediation* and in subsequent articles which expand on their book's theories, Jay David Bolter and Richard Grusin react to Baudrillard's theories on simulacra and simulation with their own complementary concepts of mediation and remediation. In Bolter and Grusin's view, CyArk's digitisation of Mount Rushmore, for instance, is not simply a simulation of reality, but only the latest step in an ongoing story of remediation: CyArk's Mount Rushmore remediates an already existing rock carving, which in turn was remediated from a sketch, which itself was based on photographs and paintings. The digitisation of cultural heritage, architectural sites and artistic artifacts are not a direct mediation of material reality as such, since these cultural objects and sites are themselves already the product of cultural remediation. At first, Bolter and Grusin's conviction that remediation is an unstoppable and ubiquitous force may mirror Baudrillard's perspective on the 'omnipotence of simulacra'.[123] Their equivalent to Baudrillard's 'the simulacrum is true' may be their statement that 'all mediations are themselves real.'[124] From this, however, Bolter and Grusin do not draw Baudrillard's subsequent conclusion that the truth of the original must therefore be undermined by its remediation. Instead, they opine that '[j]ust as there is no getting rid of mediation, there is no getting rid of the real.'[125] Reality is not discarded through the introduction of advanced simulation, but instead transformed by a plethora of digitally created alternatives: '...because all mediations are both real and mediations of the real, remediation can also be understood as a process of reforming reality as well.'[126] Here, the virtual is simply another iteration of reality, and does not completely inundate and annihilate it, as Baudrillard seems to believe. Bolter and Grusin seem to echo Slavoj Zizek's perspective on virtuality, characterising it as yet another avenue for approaching the multidimensional Real.

And yet, Bolter and Grusin are not as distinct from Baudrillard as one may think. The scholars point to an etymological resonance of remediation with 'the Latin *remederi*—to heal, to restore to health' which Bolter and Grusin speculate could be an apt descriptor for the continual process of one medium 'reforming or improving upon another.'[127] Remediation as a chain of continual improvement is particularly noticeable in the 'repurposing of earlier media into digital forms.'[128] Bolter and Grusin trace the evolution from broadcast television to interactive digital

[123] J. Baudrillard, 'Simulacra and Simulations', p. 172.
[124] J. D. Bolter and R. A. Grusin, 'Remediation', p. 346.
[125] Ibidem.
[126] Ibidem.
[127] J. D. Bolter and R. A. Grusin, 'Remediation', p. 350.
[128] Ibidem.

television, from post to email, and from film to virtual reality, the latter of which 'improves upon film by placing the viewer at the center of a moveable point of view…'[129] Here, simulacra are multiplying indefinitely towards a refined and improved transmission of an original object's essential content. The idea here is that 'a new medium is now expected to justify itself by improving upon a predecessor'[130] and that it is likely not to survive the test of time if it does not add some surplus of value. Clearly, this blanket assumption of guaranteed improvement through remediation is problematically selective. Not unlike Baudrillard, who expressed faith in the simulation but distrusted reality, Bolter and Grusin's vision ultimately undermines the authority of the original. They dream of moving the cultural object through continual stages of mediation and remediation, advancing it towards an improved iteration that cannot, in the end, be anything other than a severe distortion of the original.

In *Interface Fantasy: A Lacanian Cyborg Ontology*, André Nusselder makes a useful observation regarding the evaluation of material reality versus its virtual counterpart, leading him to introduce a distinction between *simulation* and *suppletion*. Simulation denotes a replica to which reality is still superior, as would presumably still be the case with most virtual heritage experiences. Suppletion, on the other hand, refers to the virtual at its most evolved and effective stage, threatening to functionally supplant the material with its superior facilities: '[h]ere it is the real that is impartial, lacking and, and imperfect.'[131] To reframe the term as a self-descriptive portmanteau, suppletion is produced by technologies which *supplement* reality so well that they *deplete* it. The powerful effect of suppletion may be part of the reason why Sherry Turkle claimed in the mid 1990s that '[w]e are moving toward a culture of simulation in which people are increasingly comfortable with substituting representations of reality for the real.'[132] Judging by the ascendancy of digitally shaped cultures, economies and lifestyles in recent decades, digital media seem to have successfully identified the flaws and limitations of reality, and provided an alternate one of convenient consumption, endless stimulation and instant gratification. Cultural heritage, too, may soon have to make a decision as to whether it should simulate or supplete its material collections.

[129] J. D. Bolter and R. A. Grusin, 'Remediation', p. 350.
[130] Ibidem.
[131] A. Nusselder, *Interface Fantasy: A Lacanian Cyborg Ontology*, p. 37.
[132] S. Turkle, *Life on the Screen: Identity in the Age of the Internet* (New York: Simon and Schuster, 1995), p. 23.

*4. 3. Thinking immersively: digital materiality as a cognitive phenomenon*

Paul Hegarty once commented in relation to Baudrillard's theories: 'The more simulation becomes complete, the more we have a sense of the real, of being immersed in reality.'[133] In what will be the final stretch of the argument, this subchapter will look at the role of immersivity in virtual and augmented reality theory, and argue that digital materiality must ultimately be the product of a cognitive effect, achieved through technology's effective engagement with the human brain. Generally, the digital materiality arising from currently available virtual reality technologies still struggles with a somewhat uneasy blending of the two ontological realms: VR experiences are often reported to produce physically nauseating effects, while AR objects may suffer from time-lags or inappropriate positionings and movements in space, adversely affecting an environment's immersivity, and by extension, its digital materiality.

Various critics of digitisation and digitalisation have pointed to digital media as introducing a concerning effect of fragmentation into the experience of the material. Roger Chartier has written extensively about the digitisation of print books, and claimed that their digital counterparts encourage 'a new way of reading: segmented, fragmented, discontinuous.'[134] Similarly, William J. Mitchell criticises interface designs as generally 'privileg[ing] fragmentation, indeterminacy, and heterogeneity'.[135] Accordingly, Bolter and Grusin comment on digital media's 'hypermediacy' which 'is most evident in the heterogeneous, windowed visual style of World Wide Web pages, the desktop interface, multimedia programs, and video games', and which is still very much present in the interfaces of projects like CyArk.[136] These fragmentational design choices may stem from the nature of digital ontology itself, and its necessity to hierarchise, compartmentalise and categorise information. The fragmentary and heterogeneous nature of the digital is further reflected in the digitisation process itself. The digitisation of a real object or location requires a rigid selection process of those parts which are deemed vitally constitutive of its experience, and therefore worthy of being replicated in code. As Mattessich puts it: 'the hopeless undertaking of representing absolute reality in its totality, forces us to be satisfied with simulating it, that is representing mere chunks of reality and their structure by conceptual representation.'[137] Such disjointed assemblages

[133] P. Hegarty, 'Simulation and the Decay of the Real', in: *Jean Baudrillard: Live Theory* (London: Continuum, 2004), p. 48.
[134] R. Chartier, 'Languages, Books, and Reading from the Printed Word to the Digital Text', in: *Critical Inquiry* 31, 1 (2004), p. 151.
[135] W. J. Mitchell, *The Reconfigured Eye: Visual Truth in the Post-Photographic Era* (Cambridge, Massachusetts: MIT Press, 1992), p. 8.
[136] J. D. Bolter and R. A. Grusin, 'Remediation', p. 327.
[137] R. Mattessich, 'Accounting Representation and the Onion Model of Reality: A Comparison with Baudrillard's Orders of Simulacra and His Hyperreality', p. 458.

of ‘mere chucks of reality’, however, work against the goal of producing immersivity through a cohesive, fully engulfing vista of simulated space. The perceptual amalgamation of these ‘chunks’ may only be accomplished through the invention of ‘a technology of mediation whose purpose is to disappear’[138] and through a quasi-invisible interface design that creates ‘perceptual immediacy’ and an ‘experience without mediation’.[139]

Besides doing away with the excess of formal or structural elements, as well as implementing higher-quality visuals, sensory clues and interactive features, how could virtual cultural heritage spaces become truly immersive? On a more experimental note, one may try to increase the immersivity levels of a digital environment, not through a more refined and sophisticated materialisation of digital objects, but through a dematerialisation of the human body. N. Katherine Hayles writes in some depth about the neurologically puzzling effects of sophisticated VR technology which ‘puts the body into an intense and direct feedback loop with a simulation.’[140] This results in an eerie ‘deactualization of the body’, in which the human brain is tricked into over-identifying with its non-material surroundings.[141] The mind enters a state of cognitive disconnect from the body, feeling wholly ‘amputated’[142] and detached from its corporeal form: ‘[p]roprioceptive sense flows out of the body to meet the artifact, but since there is no material object, it returns in a feedback loop that acts to dematerialize the body.’[143] Here, the abstractive nature of digital media plays a neurological trick on our proprioceptive sense, leading to a displaced and dematerialised sense of embodiment. As a VR user turns their head, the scene changes, and according to Hayles, this ‘link between proprioception and vision further reinforces the user’s sense that the body is immaterial, an informational pattern interacting with the informational patterns on screen.’[144] Conversely, however, one could also argue that the *dematerialisation* of the physical body which Hayles describes actually reflects a *materialisation* of the virtual environment. When the physical turning of the head corresponds to a plausible change in virtual perspective, a digital space becomes more physically ‘real’ to the brain and body moving within it. Either way, advanced VR technology seems to employ de- and re-materialisation strategies which aim to undermine the cognitively perceived physicality of the human body. Without fully exploiting this neurological dimension, digital materiality may never come to realise its full potential.

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[138] J. D. Bolter and R. A. Grusin, ‘Remediation’, p. 315.
[139] Ibidem, p. 316.
[140] N. K. Hayles, ‘The Materiality of Informatics’, in: *Configurations* 1, 1 (1993), p. 167.
[141] Ibidem.
[142] N. K. Hayles, ‘Embodied Virtuality: Or How To Put Bodies Back Into The Picture’, in: *Immersed in Technology: Art and Virtual Environments*, ed. M. A. Moser and D. MacLeod (MIT Press, 1996), p. 1.
[143] N. K. Hayles, ‘The Materiality of Informatics’, p. 167.
[144] Ibidem, p. 169.

Interestingly, Hayles goes one step further in her analysis by characterising computational spaces as externalised parts of the brain: 'cognition should not be seen as taking place in the brain alone. Rather, cognition in their view is a systemic activity'.[145] This systemic activity exceeds the limits of brain and body and extends into the newly grown appendages of digital technology. Hayles consciously echoes philosopher Andy Clark's description of the human brain's 'recruitment and exploitation of non-biological props and scaffolds' which, unlike tools or other cultural products, do not work as a simple 'wraparound', constructed on top of our natural capabilities, but are instead intricately fused with them.[146] Clark's idea results in what Hayles succinctly reformulates as 'thinking and reasoning systems whose minds and selves are spread across biological brain and non-biological circuitry.'[147] Clark's paradigm of the 'extended mind'[148] relies precisely on the brain and body's immersion into a digital supra-organism. For Žižek, it is therefore fitting to say that 'we conceive of the brain itself as a "computer made of flesh and blood."'[149] In his upcoming book *Hegel in a Wired Brain*, he will investigate this connection more closely, taking the example of the controversial Neuralink project.[150] The Silicon Valley-based neurotechnology company is ostensibly spearheading research into direct brain-to-digital and even brain-to-brain connections, almost as though it were inspired by the science fiction of Kevin Warwick, who wrote in his 2002 novel *I, Cyborg*: '[w]e will interface with machines through thought signals. We will become nodes on a techno-network. We will be able to communicate with other humans merely by thinking to each other.'[151] Incidentally, Nusselder also cites this passage in his book, going so far as to predict that such '[t]echnological communication in virtual space' will be 'seen once again as a liberation of our limited, physical relations.'[152] At this level of enmeshment with human neurology and physiology, VR may soon resolve old questions about the mind-body problem, while also giving rise to countless new ones. True immersivity, then, not only involves interface designs that are relatively unobtrusive and invisible, but might also one day require the literal immersion of the brain into a computational network. For the virtual to be thought of as material, grey matter itself may have to become virtual.

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[145] K. Hayles 'Flesh and Metal: Reconfiguring the Mindbody in Virtual Environments', in: *Configurations* 10, 2 (2002), p. 302.
[146] A. Clark, 'Natural Born Cyborgs?'.
[147] K. Hayles 'Flesh and Metal: Reconfiguring the Mindbody in Virtual Environments', p. 302.
[148] A. Clark, 'Natural Born Cyborgs?'.
[149] S. Žižek, 'From Virtual Reality to the Virtualization of Reality', p. 295.
[150] For a paper issued by Neuralink on their product, see E. Musk, 'An integrated brain-machine interface platform with thousands of channels', in: *bioRxiv*, 02 August 2019 <https://doi.org/10.1101/703801> (30 June 2020). For Žižek's book, see Bloomsbury UK's information on 'Hegel in a Wired Brain', to be published on 23 July 2020: <https://www.bloomsbury.com/uk/hegel-in-a-wired-brain-9781350124417/>.
[151] K. Warwick, *I, Cyborg* (London: Century, 2002), p. 2-3.
[152] A. Nusselder, *Interface Fantasy: A Lacanian Cyborg Ontology*, p. 58.

*5. Encoding the past, envisioning the future*

Virtual cultural heritage projects strive to create a simulation of reality that strikes its users as *digitally material*. At their current stage, VR and AR cultural heritage achieve a degree of digital materiality that is quite advanced, in that it faithfully reproduces a predominantly visual impression of spatially substantive surroundings, while exploiting the unique affordances of the digital medium to create an experience that is distinct from, and sometimes even preferable to, in-person access. At present, digital materiality still exists within the unclosable gap between the digital and the material, and a phenomenological synthesis of the two may be more in reach than an ontological one: VR and AR will likely succeed in aesthetically and sensorially tricking human brains into perceiving a successfully fused digital materiality. On the level of ontology, internal structure and existential nature, however, the digital and material will likely remain separate, only differentiating themselves to ever greater degrees.

Besides having to create an optimally balanced and cohesive sense of digital materiality, cultural heritage projects are also tasked with negotiating what Freeman et al. refer to as 'the relationship between matter and memory' and 'the glances, seductions, and revulsions that arise through encounters with the visual, tactile, textual, and synesthetic expressions of the past.'[153] The successful implementation of digital materiality and digital sensuality within cultural heritage should ultimately lead towards a more accessible, emotionally impactful and collectively shared memory practice. Freeman et al. instructively elaborate:

> 'Objects become mnemonic things when they become part of a meaningful assemblage, when they have rubbed up against the human in a memorable way (or when the human has rubbed up against them), and when traces of past experiences have been created with and held within them.'[154]

It is clear that the mechanism of memory building involves contextual embedding, an obvious strong suit of digital technology, which, if harnessed effectively, could immensely contribute to building historical knowledge and consciousness in future generations. In the context of studying the educational effects of teaching through virtual interactive environments, Charles Wankel and Randy J. Hinrichs have commented on significant improvements when comparing the linear

[153] L. A. Freeman, B. Nienass and R. Daniell, 'Memory , Materiality , Sensuality', in: *Memory Studies* 9, 1 (2016), p. 4.
[154] Ibidem.

learning-style encouraged by 2D diagrams to the multidimensional and multimodal learning-system enabled by 3D designs. Whereas the former is based on 'describ[ing] the inflows and the outflows' of a process and works in a manner that is 'sequential' and 'rule dominant', the latter enables participants 'to interact with objects in real-time within context, making the solution all more meaningful.'[155] The digital ability to capture changes over time becomes especially useful to cultural heritage that is interested in displaying historical processes and in building memorable narratives around itself. The interactivity, dimensionality, temporality, mobility and materiality simulated within virtual spaces can be uniquely engaging from the perspective of educational and collective socio-cultural recollection. In his writing on autopoietic systems, Steffen Blaschke refers to an often cited distinction in the German language between *Gedächtnis* as 'a matter of communication and consciousness and thus recognition and recall' and *Speicher* as 'the storage and retrieval of data.'[156] Digital presentations of cultural heritage should not fall into the trap of merely becoming preservatory storage space, but should instead focus on creating tools for the thoughtful selection, arrangement and experience of these objects, so that they may 'rub off' on users, and provoke lasting, memorable and meaningful effects.

Finally, the hybridised realities created in virtual and augmented cultural heritage projects provide a practical space wherein diverse theoretical approaches to the problem of digital materiality can be experienced and evaluated. Up until now, theoretical or philosophical questions on this matter have rarely led to concrete technological experimentations that could directly verify or falsify a hypothesis. However, taking a more scientific approach to philosophy, especially when the philosophy is so deeply concerned with a scientific topic, is certainly worth considering. Philosophers in this field would usually rely on drawing what is of interest to them from already existing technological projects. Rarely are they invited to modulate unfinished projects according to their research needs or consulted for their special expertise during the development process. This disconnect between the sciences, which produce technical advances and innovations independently, and the humanities, which are left to interpret the greater implications of these advances retroactively, is borne out of a missing awareness - on both sides - for what the humanities can offer to the study of virtual and augmented reality. In the research leading up to this thesis, the most philosophically developed approaches to the ontology of the digital realm were published in the 1990s and early 2000s, when an expansive digital landscape was first opening up to larger masses of consumers. Even earlier, the work of Marshall McLuhan or Jean Baudrillard did not shy away

[155] C. Wankel and R. J. Hinrichs, *Transforming Virtual World Learning* (London: Emerald Group Publishing Limited, 2011), p. xv.
[156] S. Blaschke, *Structures and dynamics of autopoietic organizations* (Wiesbaden: Springer-Verlag, 2008), p. 95.

from an interdisciplinary engagement with technologically mediated simulations and representations. It seems that at the early dawn of digital mass media, academics were less eager to retreat into the confines of their own discipline, and less squeamish around venturing outside of it. Since then, of course, technologies have become considerably more complex and sophisticated. This seems to have led to a regrettable dearth of technological inquiry by humanities scholars, who may suffer from a lack of confidence, encouragement or resources to adequately research and build reliable expertise around digital technologies. Vice versa, computer scientists are generally not equipped to connect their research with greater philosophical concerns or to collaborate with experts outside of their own departments. In the near future, more daring, far-reaching and interdisciplinary research ought to be done to facilitate philosophical advancements alongside scientific ones. The field of virtual cultural heritage is only one of many conceivable places at which this intersection could prove fruitful.

In this thesis, it has been shown that the digital and material remain in a dialectical, mutually constitutive and tightly interlocked relationship. While they may be steadily approaching each other, their essential ontological distinctness makes it difficult to imagine the direction of this movement as anything but asymptotic. Considering the unique strengths and benefits each brings to the table, however, a fully homogenised synthesis may not even be in the best interest of cultural heritage objects. While it may be somewhat inevitable, digital mediation should avoid, as much as possible, 'the perverse effect of drawing the user's attention away' from material heritage itself.[157] Throughout their continual development, digital reproductions of reality, whether they be immersively virtual or partially augmented, must not become ends in and of themselves, but remain in respectful service to the material objects they seek to immortalise.

[157] Digital humanities luminary Alan Liu once lamented this in regards to a virtual reality project created around Dante Gabriel Rossetti's studio: A. Liu, 'The State of the Digital Humanities: A Report and a Critique', in: *Arts and Humanities in Higher Education* 11:1–2, 1 December 2011, p. 15.

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