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ARTIFICIAL INTELLIGENCE AND CULTURAL HERITAGE: DESIGN AND ASSESSMENT OF AN ETHICAL FRAMEWORK

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ABSTRACT:

The pioneering use of Artificial Intelligence (AI) in various fields and sectors, and the growing ethical debate about its application have led research centers, public and private institutions to establish ethical guidelines for a trustworthy implementation of these powerful algorithms. Despite the recognized definition of ethical principles for a responsible or trustworthy use of AI, there is a lack of a sector-specific perspective that highlights the ethical risks and opportunities for different areas of application, especially in the field of Cultural Heritage (CH). In fact, there is still a lack of formal frameworks that evaluate the algorithms' adherence to the ethical standards set by the European Union for the use of AI in protecting CH and its inherent value. Because of this, it is necessary to investigate a different sectoral viewpoint to supplement the widely used horizontal approach. This paper represents a first attempt to design an ethical framework to embody AI in CH conservation practises to assess various risks arising from the use of AI in the field of CH. The contribution presents a synthesis of the different AI applications to improve the preservation process of CH. It explores and analyses in depth the ethical challenges and opportunities presented by the use of AI to improve CH preservation. In addition, the study aims to design an ethical framework of principles to assess the application of this ground-breaking technology at CH.

1. INTRODUCTION

Rapid urbanization, climate change, and natural disasters in this century pose challenges to the survival of Cultural Heritage (CH), and reducing and mitigating their impact is one of the goals of the UNESCO 2030 Agenda (Khalaf, 2020). Catastrophes like the Notre Dame cathedral fire in Paris in 2019 and the destruction of ancient monuments, such as the one in Palmyra (Syria), by armed conflicts and terrorism attacks, point out the vulnerability of CH and the need to improve its preservation practices (Malik et al., 2021). For this reason, cultural institutions are increasingly opening to new technologies and taking advantage of the incredible opportunities offered by the digitization of CH to support longer-term preservation. In this context, the perks that AI can provide for CH conservation practices have recently grown in significance. The creative and cultural sectors have recently been impacted by AI, creating new potentials and challenges. For example, while restoring and reconstructing works of art, it is possible to replicate them in a highly detailed manner thanks to Augumented Reality (AR) modeling and 3D scanned of CH artifacts (Acke et al., 2021). Consequently, these technical supports make visible details often hidden from the naked eye, analyzing brushstrokes to identify painters' styles or examining samples of paintings with various layer builds (Malik et al., 2021). It is well known that AI is an effective method for analyzing extensive quantities of data. Deep neural networks (DNNs) are used in CH to describe and categorize works of art automatically. In order to address issues with attribution and interpretation, DNNs may also be used to identify the author, context, and time period of the work (Felicetti et al., 2021). Generative Adversarial Networks (GANs) have recently been successfully employed for picture overpainting and image restoration (Shahriar, 2022). This approach can develop techniques to assist conservators and restorers in reconstructing damaged or missing frescoes and mosaics. Nevertheless, when it pertains to art and creativity, there are a lot of significant social and political implications to consider. CH is not just a static object of Outstanding Universal Value [1] to be preserved and maintained but encompasses a range of meanings and identity values that change over time. Therefore, it is essential to recognize AI's potential for CH preservation and diffusion. On the other hand, it is crucial to outline ethical and moral considerations when employing AI in a cultural context. Based on an analysis of the current state of the art, this paper outlines the ethical challenges of AI in the context of CH. In particular, the use of AI for conservation of living CH may be subject to cultural and historical biases, and there is a risk that minorities will not be represented. Secondly, the digitization of CH can lead to problems related to artificial reproduction such as authenticity or replacement of the physical artwork. Other challenges related to the distribution of economic resources, the allocation of responsibility, and the protection of privacy emerge from the analysis of the literature and should be considered for a trustworthy application of AI in CH. For this reason, when using AI at CH for conservation purposes, a human-centred AI approach should be adopted that puts the human interest at the centre (Pisoni et al., 2021). In this scenario, the adoption of human-computer interaction (HCI) is essential to enhance CH restoration and conservation practises without undermining the role of art historians, archaeologists, and other humanists. In response to the ethical challenges identified, this paper provides an ethical framework consisting of six core prin-

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[1] https://whc.unesco.org/en/compendium/action

ciples - shared responsibility, cultural continuity, economic accessibility, right to be forgotten, centrality of the physical space - that can guide computer scientists and heritage professionals in identifying and addressing these ethical risks they may encounter. The aim of the entire study is to provide sectoral ethical principles for a fair use of AI in tangible CH to support and promote its long-term preservation without undermining its values, significance, sense of community, and social impact.

This paper attempts to move away from general ethical principles contained in national and international regulations on the application of AI. Indeed, ethical principles and guidelines are often perceived as abstract by those who are supposed to apply them, namely computer scientists (Peters and Calvo, 2019). Therefore, defining an ethical framework for a specific domain (art, culture, life sciences, medicine) that can be combined with the general one is of utmost importance to make AI ethical principles less abstract and more readily applicable to the context at hand who are supposed to apply them (Peters and Calvo, 2019).

The main contributions of this research can be summarized as follows: i) Illustrate the broad range of applications of AI to improve heritage conservation practices; ii) Rise awareness of the opportunities and risks arising from the use of AI for CH conservation; iii) Provide professionals and computer scientists with a tool to assess, on a case-by-case basis, whether the use of AI models in the cultural domain is ethical and human centred; iv) Encourage and regulate the combination of CH and new technologies, promoting a multidisciplinary approach.

The paper is organised as follows: Section 2 illustrate the workflow and methodology followed for the construction of the Ethical Framework. Moreover, it provides an analysis of the state of the art, outlining of the various best practices and benefits for using AI for conservation of CH as well as the main ethical pitfalls of CH preservation using AI models. Situations in which the use of AI can undermine the continuity, authenticity, inclusion, and interpretation of CH are presented. Section 3 presents the result of this research, that is the design of an ethical framework for AI in CH field. Finally, in Section 4, conclusions and future directions of study are discussed.

2. MATERIALS AND METHODS

The following methodology was uses in the creation of the ethical framework. First, a state of the art analysis was conducted to explore the various applications of AI for CH conservation and the ethical concerns that may arise from the application of these technologies in a field where identity, moral, and religious values are at stake for various audiences. The leading European guidelines for trustworthy implementation of AI, on the one hand, and the ethical guidelines for the preservation and documentation of CH provided by international organisations such as UNESCO and ICOMOS, on the other hand, were used as reference sources for the analysis of the ethical pitfalls encountered. Based on the guidelines derived from these sources, a sectoral ethical framework consisting of six ethical principles was developed to address the risks arising from the use of AI in the field of CH. The workflow followed to develop the ethics framework is illustrated in Figure 1.

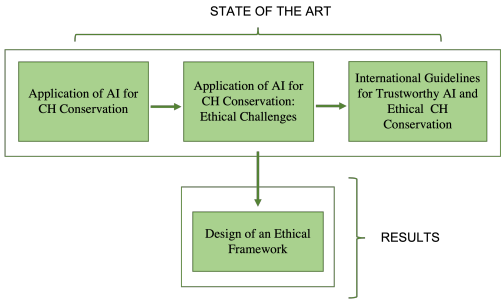

Figure 1. Methodology Workflow

Analysis of the various applications of AI in the field of CH preservation reveals opportunities and ethical pitfalls that will be analyzed and deeply explored below.

2.1 AI for CH

CH is a valuable asset that has been passed down from generation to generation. It is the embodiment of the collective memory of a society, reflecting its history, values, and beliefs. Tangible CH, which includes artifacts, buildings, monuments, and landscapes, is a physical manifestation of this heritage. However, the preservation of tangible CH has been a significant challenge due to natural and human-made threats, such as climate change, natural disasters, war, and vandalism. In recent years, technological advancements have revolutionized the way we interact with our CH. Digital technologies have made it possible to preserve, document, and share tangible CH with wider audiences, regardless of geographical location or physical barriers. The conversion of tangible CH into digital format has opened up new possibilities for research, education, and entertainment. Digital technologies have enabled the creation of virtual museums, online exhibitions, and interactive learning platforms, offering a new level of engagement with CH. Geomatics, which is the science of acquiring, processing, and interpreting spatial data, has made significant contributions to the documentation and digitization of tangible CH. Geomatics technologies, such as photogrammetry, LiDAR, and 3D scanning, allow for the creation of accurate and detailed digital models of CH sites and artifacts. These digital models can be used for research, conservation, and public education purposes. Furthermore, geomatics has enabled the creation of virtual reality (VR) and AR experiences that offer immersive and interactive ways of experiencing CH. Geomatics has thus become an essential tool for preserving and sharing tangible CH with future generations.

The combination of geomatics and AI has opened up new possibilities for the management of digital cultural heritage (DCH) (Pierdicca and Paolanti, 2022). AI algorithms can analyze and interpret large datasets of geospatial and historical data, providing insights into the significance and context of CH sites and artifacts. This can inform conservation and preservation efforts and aid in decision-making processes. Moreover, AI can assist in the creation of digital models of CH, allowing for accurate reconstructions and simulations. This combination of geomatics and AI also enables the development of intelligent systems for the interactive and immersive exploration of DCH, enhancing the user experience and promoting cultural awareness (Vasic et al., 2022).

AI can be applied to CH using convolutional neural networks (CNN), region-based CNN (R-CNN), and GANs, which can be used to analyze and interpret visual data and classify objects

within images, and even generate new images of cultural artifacts or sites based on existing data. Similarly, AI systems can be used to automatically describe and classify works of art. A very notable application of these methods is the so-called "Saint George on a Bike"[2] project, the result of a joint effort between Europeana and Barcelona Supercomputing Center (BSC). The project aims to enrich the metadata of CH on a large scale by using high performance computing (HPC) resources to train AI models. To this end, deep learning algorithms will be used to train a model based on tens of thousands of images and text descriptions. In this way, it will be possible to automatically generate descriptions for hundreds of thousands of images from various CH archives that reflect an understanding of culture, symbols, and historical context. The richness of the annotations will enable good indexing, leading to improved access to collections and a better browsing experience in collection catalogues. These results can be used for educational, creative, or tourism projects. AI has made significant contributions to the field of CH, especially in deciphering ancient languages, restoring ancient text using deep learning, and automatic identification of objects. Furthermore, AI can assist in the restoration of damaged or incomplete ancient texts, using deep learning algorithms to fill in the missing parts (Rizk et al., 2021). In addition, AI can be used for the automatic identification of objects in CH collections, including point cloud and image classification and segmentation (Grilli et al., 2017). This can assist in the organization and management of CH collections, making them more accessible and usable for researchers and the public. AI can be used for the automated mapping of CH from lidar data, which involves using machine learning algorithms to analyze and interpret the 3D point cloud data generated by LiDAR sensors to identify and map archaeological sites and other CH assets (Trier et al., 2021, Argyrou and Agapiou, 2022).

It can also automate 3D digitization procedures, reducing the time and resources required for digitization and enabling wider accessibility to CH (Espina-Romero and Guerrero-Alcedo, 2022). Virtual reconstruction and restoration through AI allow for accurate and detailed reconstructions of historical sites and objects, offering immersive experiences to visitors and researchers alike. AI can aid in the protection and inheritance of CH, providing innovative solutions for the preservation of our shared history and CH for future generations (Wang, 2022). An AI-based visual inspection system can be applied to structural health monitoring of CH sites, where machine learning algorithms can analyse visual data from sensors and cameras to identify and detect potential structural damage or degradation in a timely and accurate manner (Mishra et al., 2022, Mansuri and Patel, 2022). Other potential application of AI in CH is semantic enrichment through image analysis, which involves using machine learning algorithms to analyze and interpret visual data in order to improve our understanding and interpretation of historical artifacts and artworks (Abgaz et al., 2021). AI can also support in the detection of unknown CH sites, helping to uncover previously unknown historical and archaeological treasures. Additionally, AI can be used to detect and monitor changes in CH sites and artifacts, allowing for early intervention and preservation. Prediction of risk and emergency situations using AI can help protect CH from potential disasters, such as natural disasters (Granata and Di Nunno, 2021) or vandalism (Fangi et al., 2017). Additionally, AI can assist in the historical property retrieval, allowing for the identification and return of stolen or illegally traded CH artifacts. Furthermore, AI can also be used for crime heritage detection on the internet, to identify and combat the illegal trade of CH artifacts (Abate et al., 2022). AI is also a powerful tool for predicting the risk of natural disasters, enabling informed action and damage prevention in vulnerable areas. An important case in this regard is the prediction of tides in the Venice Lagoon by AI algorithms. In particular, the conducted study shows how the implementation of different ML algorithms such as M5P Regression Tree, Random Forest and Multilayer Perceptron can predict the tide level in the Venice Lagoon with a good accuracy (Granata and Di Nunno, 2021). This kind of predictions are a great help for a conservation approach that aims at prevention rather than reconstruction and restoration.

[2] https://saintgeorgeonabike.eu

2.2 AI FOR CH CONSERVATION: ETHICAL PITFALLS

In this scenario, AI is recognized as an explosive tool that can improve CH preservation and interpretation. Despite the tremendous benefits AI offers to the cultural sector described above, some ethical issues must be considered. In particular, ethical concerns regarding cultural and historical bias, attribution of responsibility, high economic investment, authenticity, privacy, and the risk of physical CH replacement arise from the use of AI in CH and the resulting digitization process.

2.2.1 Cultural and Historical biases: One ethical concern is related to the selection and interpretation of CH for digitiza-tion and conservation of living heritage sites used and inhabited by local or indigenous communities. It is necessary to think more deeply about the role that technology plays in CH's pro-cess of democratization (Waterton, 2010). In fact, many con-tend that digitization procedures, aimed to conservation, fre-quently serve as a means in and of itself, and are conducted top-down, ignoring various factors pertaining to the target area and the local population (Ocón, 2021). When interpreting and documenting CH through AI models, there is a danger that the history of marginalized races and groups would be overshad-owed or overlooked. The main risk in this context is related to a biased application of CH metadata schemas resulting from a biased Western approach to the vision and interpretation of the past (Manžuch, 2017). When AI is used to document and reconstruct CH, the information used to train the AI models is unlikely to be completely objective but will inevitably be influ-enced by the current thinking of those analyzing the work. This will influence the results, which may lead to reproductions that are not representative of minorities and may introduce cultural-historical biases. It is common in "Western" culture to classify and describe metadata to describe indigenous history. Attempting to incorporate indigenous knowledge and spirituality into a "Western" worldview through the use of metadata risks undermining the authenticity of local cultures (Whaanga et al., 2015). AI enables the digitization and virtual 3D reproduction of CH and often provides free access to it. Some cultural assets are conceived ad sacred and secret for the living communities and access to them is often restricted to people of a certain age or gender. For this reason, the digital replication of the site or the free digital access enabled by these technologies are at odds with the worldview and traditions of the community. By overlooking community needs and values, discrimination against the community that created this history is reinforced (Manžuch, 2017). This bias is at odds with the commitment of cultural institutions to present multiple perspectives on this issue and to promote cultural diversity and mutual conversation (Manžuch, 2017). In certain situations, such as CH indigenous communities, it is important to consider the dangers of increased accessibility to all that digital reproduction would bring to the social

frame of reference. The cultural minority would certainly be excluded from a digitization process if the group that owns that history does not have the resources to process it and risks not being represented. Therefore, some aspects of digitization have been considered as neo-colonial practices that have been extended (Boast, 2011).

2.2.2 Justification to destructin: Another ethical concern is that the use of AI for digitization and virtual replication of CH repair or conservation projects could serve as a cover for its destruction (Ocón, 2021). This runs the risk of defending the demolition of urban structures that the reference community values historically and aesthetically but which are not protected against demolition since they are not national heritage assets. In these situations, methods like 3-D modeling and reproduction, which offer digital access to this heritage, may be used to justify destruction for other, purely commercial reasons, like the construction of urban structures with commercial uses that offer greater economic incentives or revenue.

2.2.3 Responsibility attribution: Additionally, where duty falls when algorithms have varied degrees of agency to act is another problem that arises with the application of AI in CH conservation and archaeological practice, particularly when their actions cause harm or have unfavorable effects. Since the archaeologist or art historian is just the final a ctors i n a n ethical chain of accountability, ethical responsibility might be addressed at them (Floridi, 2019). It is crucial to clarify whether the algorithm may be viewed as an ethical actor or if its programmers and users are the only ones accountable for its behavior (Huggett, 2021).

2.2.4 High Economic Investment: Many can argue that access to AI technologies requires significant economic investment and highly qualified personnel. As a result, cultural institutions are typically forced to take a business-oriented management approach to using these technologies by charging fees for access to digitized content, partnering with private entities, and seeking sponsor support (Verwayen, 2010). Selection bias and access constraints are two ethical concerns raised by a business-oriented approach in the public sector (Manžuch, 2017). First, in public-private partnerships, sponsors and business partners have a say in the selection and analysis of content to be digitized. In this case, selection and interpretation decisions may be influenced by the preferences of the funder or partner (Pickover, 2014). Second, private partners who have made a large contribution, whether in the form of money or digitization efforts, occasionally insist on restricting free access for a period of time because they have a profit-driven g oal. Especially if the initiative is partially funded with public funds, this raises ethical concerns about accessibility.

2.2.5 Ease of sharing and manipulation of metadata and digitized CH: The ease of sharing and manipulation of CH digital reproduction and CH metedata is another ethical hazard associated with the use of AI in CH. The use of virtual and 3D reproduction applications has enabled AI to help digital content users in a variety of ways, including reconstruction and restoration, research, learning, and educational purposes. However, the ease with which digital files can be shared and modified makes it difficult to protect the personal data they contain and determine their reliability (Manžuch, 2017). The wealth of personal information in CH documents and objects, including ethnographic materials with intimate details, opinions, references to other individuals and life events, archival records with data about individuals, newspapers, etc., raises privacy concerns when digitizing CH. Online access was often not anticipated and therefore not discussed with informants and donors of historical materials, violating the right to privacy (TERWANGNE, 2013).

2.2.6 The problem of Authenticity: Authenticity is a value ensured by Codes of Ethics of various Cultural National and International organism such ad International Council of Archives (ICA) code of ethics, the IFLA code of ethics for librarians and information professionals, and the International Council of Museums (ICOM) code of ethic. The concept of authenticity is a widely debated issue when it comes to the reconstruction and restoration of CH. In fact, while in the past there was a predominant preference for restorations that involved reproducing and remaking the work of art, today there is an increasing tendency to want to preserve the original traces of the work even if they are damaged or ruined so as not to harm its authenticity. When using the term ”authenticity,” reference is made to the material of the original artwork as the only source of genuine traces of the past and a relationship to the artist (Malik et al., 2021). In this context, the use of AI to support restoration and reconstruction systems becomes an important topic of discussion. If it is difficult to preserve the authenticity of a work when restoration decisions are made by professionals, how can it be possible to trust the decisions of computers, i.e. a machine, in the reconstruction of creative and inherently human works? Some claim that online interactive 3D representations are not representative of the original and can dehumanize CH (Manžuch, 2017). The question of authenticity has always been much discussed and taken up by various authors. Indeed, the work of art is often considered unique and capable of generating an ”aura”, that is, a poetic and political gaze in the viewer, and that any reproduction will not be able to replace the physical experience of the “hinc et nunc” (Benjamin, 2017). In this very complex context, AI must be able to defend itself against the accusation of violating the uniqueness of the work by compromising its aesthetic sense, and to present itself as a supportive tool capable of preserving and protecting this uniqueness through the application of an ethical framework.

From the ethical issues raised, including the need for adequate representation of minorities, the need to protect the physicality of the artwork, the regulation of metadata sharing, the question of economic autonomy of cultural institutions, the problem of authenticity, and the assignment of responsibility for the results of AI models, there is a need to establish an ethical framework to morally regulate the use of AI at CH (what should or should not be done/what ethical hazards should be considered/prevented and/or mitigated).

3. RESULTS:ETHICAL FRAMEWORK

Based on the industry best practices and associated ethical challenges listed above, ethical principles were outlined to guide computer scientists and domain experts in implementing this powerful technology in the cultural sector. These principles were defined u sing t he p rimary i nstitutional r eference sources worldwide on AI, privacy, and CH preservation and documentation ethics. First, the White Paper on AI published by the European Commission (European Commission, 2020) and the European Union General Data Protection Regulation (European Parliament and Council of the European Union, n.d.) were considered. Second, the ICOM Code of Ethics and the UNESCO Recommendation on the Ethics of AI were analysed.

Finally, the guiding principles for Recording, Documentation, and Information Management for CH Preservation promoted by the Getty Conservation Institute were consulted to inform this framework further. To improve the applicability of the framework, this paper attempts to assign to each of the above ethical challenges an ethical principle to be considered when the problem in question arises. The European Commission released a white paper on AI in February 2020 that outlines legal solutions to encourage the secure and reliable development of AI systems (Cohen et al., 2020). According to the White Paper, trustworthiness is needed for using AI. According to the High-Level Expert Panel established by the Commission, the AI system must meet seven prerequisites to be considered trustworthy:

1. Technical robustness and safety
2. Privacy and data governance
3. Trasparency and explainability
4. Diversity, nondiscrimination and fairness
5. Societal and environmental well being
6. Accountability

To help conserve our natural, cultural, and scientific legacy, museums are responsible for gathering, protecting, and promoting their collections. According to the ICOM Code of Ethics and UNESCO guidelines, museums and cultural institutions are accountable for the physical and intangible nature and CH. Protecting and advancing CH is primarily the duty of the governing authorities and those charged with making strategic choices (Camara, 2020) . The term "stewardship" describes the idea of proper ownership, preservation, recording, accessibility, and responsible use of collections (UNESCO, 2021). The maintenance, accessibility, and interpretation of collections and CH are the responsibility of museums (Camara, 2020). In light of the ICOM Code of Ethics' guiding principles and UNESCO's guidelines, it can be said that many stakeholders, each with specific roles and objectives, must be taken into consideration while developing, putting into practice, observing, and assessing AI measures (UNESCO, 2021). For this reason, the first ethical principle to be defined are the one of Shared Responsibility and Cultural Continuity. The principle of shared responsibility comes into play when it proves difficult to assign responsibility for the results of the AI models used. This shows that the various actors involved in the decision-making process are responsible for the actions taken. For this reason, both Computer Scientist and the Architects or Cultural Managers are held accountable for the actions taken with the help of AI. However, it is important to underline that a prerequisite of the accountability of all the actors involved is the Explainability of AI models. In fact, it is crucial to increase the transparency of AI models and justify AI-based results with a rationale that is understandable to non-technical users, such as art historians, archaeologists, as well as audiences and communities. Therefore, a multidisciplinary strategy that should ensure the responsibility of algorithms from different points of view is a prerequisite for the application of AI in CH. It is essential to help shape and evaluate the process and outcomes through a participatory AI policy approach. Principle of cultural continuity can respond to the problem of application of biased metadata schemas of CH. The principle of cultural continuity, means considering the perspectives, meaning, and values of living communities when applying AI models and systems. AI solutions for CH should focus on a human-centered, community-based, and participatory approach. This means that digitization policies should follow a bottom-up approach that considers the needs of communities and peoples according to the values and meaning of CH. It is of great importance to involve community members in the process of metadata collection to take into account different perspectives on heritage, including those of minorities. The concept of continuity refers to values, functions, uses, practices, activities, management systems, crafts, beliefs, traditions, rituals, and other familiar connections between people and their environment over time (Khalaf, 2020) and these relationships must be incorporated into preservation and documentation processes so that cultural-historical blas are not risk being overlooked. This principle is particularly important in reconstruction after wars or natural disasters: In these cases, reconstruction and conservation processes must ensure the cultural continuity of the site, that is, the values and meanings that communities associate with their environment. Another principle to consider for using AI in CH is Economic Accessibility. To this aim, central governments should provide equal opportunities to CH by allowing them to allocate financial resources to sustain AI. One of the public responsibilities of CH institutions is to guarantee education and cultural access for all. If CH institutions were to adopt an entrepreneurial mindset, this mission would likely be undermined. To face the risk of ease to share and manipulate CH Data, it is important to consider another ethical principle already introduced by the European Union General Data Protection Regulation (GDPR). This principle corresponds to the Right to be Forgotten. The European Union's General Data Protection Regulation of the European Union, which came into force in 2016, introduces the right to be forgotten. It gives someone the ability to remove or anonymize information from the Internet and thus retain control over their personal information (TERWANGNE, 2013) When records and documents are withdrawn and destroyed, concerns arise about altering or erasing the past. These concerns are at the heart of the right to be forgotten (TERWANGNE, 2013). The need to strike an appropriate balance between access to support the public interest in research and the protection of individuals who have been mentioned, depicted, or expressed opinions in CH documents is highlighted in most practical discussions of ethical privacy concerns and the right to be forgotten in large-scale digitization projects, locating and preserving personal information is still a challenge (Manžuch, 2017). To respond to a need of authenticity, the principle of Reliability must be introduced within the framework. To assure the authenticity of the digital and virtual reproduction, it is important to evaluate the reliability of the data used to train the model. It is crucial to use data and material described by trusted CH experts to ensure reliable results in terms of description and interpretation. According to the guidelines provided by the Getty Conservation Institute for the CH conservation management, to prepare reliable dataset, the first step is to examine the adequacy of the existing source of information (Letellier and Eppich, 2015). In order to avoid the risk of unprotected CH destruction justified by the presence of a virtual or digital replica, another value to take in mind is the centrality of the physical space. This means that any AI models should be used to improve preservation processes and not to replace the tangible CH with a virtual or digital replica. Table 1 shows each ethical issue and the linked ethical principle of guidance.

Ethical Pitfalls	Ethical Principles
Responsibility attribution	Shared Responsibility, Explainability
Cultural and Historical Biases	Cultural Continuity
High Economic Investment	Economic Accessibility
Easy to share and metadata manipulation	Right to be Forgotten
Authenticity	Relability
Justification to destruction	Centrality of the physical space

Table 1. Ethical challenges and related principles

4. CONCLUSIONS

The analysis of the applications of AI in the cultural field and of ethical principles and primary legal sources governing these two disciplines led to the construction of an ethical reference framework. This framework should be consulted whenever any of the risks mentioned above emerge. The analysis of ethical risks highlighted the need to outline reference principles that can ensure the protection of CH and the values it embodies. Using advanced technologies such as AI that look to the future to preserve a legacy that bears witness to the past is a significant challenge in responding to the need to involve CH in social, political, and scientific societal c hanges. Although the ethical hazards are many, this should not demonize the applications of AI in CH preservation and reconstruction but should encourage an application that respects its social and political value.

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