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A Brief Review of Artificial intelligence Applied to Digital Conservation and Restoration of Cultural and Artistic Heritage

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Abstract. Cultural and artistic heritage has been depleted by different human and environmental factors, eliminating the vestiges of ancestral cultures. However, Artificial Intelligence has generated new alternatives for the conservation and restoration of the legacy of past generations, whose impact on today's society is reflected in the knowledge that gives rise to new knowledge.

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1 Introduction

The preservation of culture is established on the basis of social, collective and institutional dynamics and, although it is generally assumed exclusively in relation to the past and memory of a group, whose identity they share, it is important to point out that, in this care of memory and identity, all temporality is involved, present and future as well.

The future, for example, because projecting forward in time, not only with respect to identity, but also the resolution of conflicts or the generation of alternative models of social coexistence, depends, to a large extent, in addition to how the action has been acted in the past, that is, the past event itself, on how the action has been recorded, that is, the value associated with the past event itself; with the purpose that, based on this valuation of the past, the memory, future generations will be able to generate individual identity from the collective one, and vice versa. About this individual-collectivity reciprocity, in the construction and generation of culture, Edgar Morin (2005) says, for example, from the so-called "Complex Thought":

> It [cultural heritage] gives each [society] its singular identity, which is consequently that of the individuals who compose it. Culture nourishes this identity by reference to its ancestors, its dead, its traditions. The society henceforth has its name, its own personality (totem, then coat of arms, flag), its founder(s) ancestor(s), its language, its myths, its rites that inscribe its singularity in each individual, whose belonging is then lived as filiation.

Hence, patrimony, based on its Latin etymology, "patrimonium", means: "goods that one possesses from one's parents... everything that is inherited from one's parents but that also transcends what is tangibly transmitted" (RAE). Or, as López Morales (2005) puts it in Cuadernos: "To understand... that what we have and what those who come after us will inherit, whether in cultural or natural heritage, are the resources that finally determine from now on the true future of humanity".

Therefore, both cultural heritage and its preservation respond to a dynamic temporal process, as Morin (2005) notes: "Acquired in each generation, culture is continuously regenerated", for, "Each culture concentrates in

itself a double capital: on the one hand, a cognitive and technical capital (practices, knowledge, know-how, rules); on the other hand, a mythological and ritual capital (beliefs, norms, prohibitions, values). It is a capital of memory and organization, as is the genetic heritage for the individual".

That is, if we think of ourselves today, as a future generation, with respect to a remote or not so remote past, the techniques, knowledge and practices mentioned in this quote, the equivalent of the cognitive capital of culture, are new generational contributions, not only current, which are inscribed or "organized" on the capital of memory that past generations valued important to preserve and inherit, in this case, to us.

In Paul Ricoeur's words, this dynamic temporal character of culture is found in the positive sense of ideology. In its positive aspect, ideology, Ricoeur (2008) points out, "has a function of integration - tradition re-actualized through interpretations", re-actualization that, by the practical immediacy of the present, allows ideology to be imagination that re-interprets the past; as Ricoeur then points out: "In its positive aspect, ideology is a strengthening of the real", with which, the above mentioned temporal dynamics is appreciated.

But, on its negative side, ideology, Ricoeur refers, becomes distortion, deception, or, in Marx's words, inverted image of reality (Cfr. 2008); the link between imagination and reality or praxis ceases and, in accordance with what was previously established, the positive side of ideology, which consisted in re-actualizing and re-interpreting imagination of the past, becomes re-production of the past. Or as Morin points out: "Culture is both closed and open.... closed on its identity capital... in a quasi-immunological way; but it opens eventually to integrate... a technical innovation, an external knowledge".

The preservation of cultural heritage implies a complex dynamic process since it is not only developed within a culture and in relation to the individuals that make it up, but also between cultures, thus favoring not only the construction of a culture's identity, but also the construction of humanity's identity; as López Morales (2005) says: "Cultures are dynamic processes that evolve and advance due to the energy that they themselves generate and to the interaction with other cultures.... Hence, at the same time, development constitutes an undertaking that is both ambitious and complex since it is a matter of ensuring to human beings everywhere and at all levels the conditions for a dignified and meaningful life".

Likewise, according to López Morales (Cfr. 2005), since the report of the World Commission on Culture and Development, entitled "Our Creative Diversity" (UNESCO, 1996), the need to rethink culture as a dynamic process, based on cultural heritage and memory, the valuation of the past, in the present time, with a view to its impact on the future, has taken on renewed importance and greater direction, since, in the valuation of cultural heritage are not only implicit the material conditions of a culture, but, as López Morales refers: "its spiritual aspirations... the values of coexistence... the models of each community, of each people, of each nation.... in the depths of its culture".

2 Cultural Heritage

According to UNESCO, cultural heritage refers to expressions, material or artistic, that persist over time, generating a cultural identity for the people who inhabit a place (country, city or town). These are material works (buildings, cities or objects), or beliefs, traditions or knowledge, which survive the years.

Subsequently, the category of intangible or intangible cultural heritage was created, forming, in 2023, the UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage, which seeks to recognize and preserve the festivals, traditions and beliefs of the various peoples of the world, as a cultural heritage that identifies humanity (UNESCO, 2024).

This intangible or immaterial cultural heritage, which includes, for example, regional dances or music, typical food or popular festivals, identifies, unites and moves the members of a society. They survive time and are passed on from generation to generation.

In the same way, material or tangible heritage, i.e. buildings, monuments and archaeological sites that form part of the everyday landscape, become points of reference, historically and emotionally, for people, so that if something happens to them or damages them, there is a social reaction to defend them. It is a sense of appropriation and belonging, which requires preserving and protecting this heritage (UNAM, 2024).

To preserve and restore, if necessary, tangible cultural heritage, Mexico has specific regulations: the Federal Law on Archaeological, Artistic and Historic Monuments and Zones, which establishes as activities of public utility, the research, protection, conservation, restoration and recovery of archaeological, artistic and historic monuments and monument zones in the country. The Ministry of Culture, the National Institute of Anthropology and History (INAH), and the National Institute of Fine Arts and Literature (INBAL), are the guiding and regulatory institutions in this matter (Chamber of Deputies, 1972).

Thus, the INAH is constituted, by law, as the guiding, normative and executive area in Mexico, for the conservation of its movable and immovable property, of a paleontological, archaeological and historical nature. Thus, it plans, coordinates and links programs, projects and processes for the conservation and restoration of cultural heritage throughout Mexico, in liaison with various agencies and bodies.

Given that they are manifestations that survive history, the aim is to ensure that tangible cultural heritage is, firstly, preserved in the best possible condition and, secondly, restored, if required.

Much of the tangible cultural heritage (for example, archaeological sites, according to the law) is declared of public utility and is controlled by the State, but there are also works, buildings or sites that are in the hands of private individuals, who are obliged to ensure their protection and preservation, as mandated by the law, subject to the regulation of the authorities indicated therein.

The design and development of conservation and restoration projects for archaeological and historical monuments must necessarily be reviewed by INAH, and a large part of them are carried out by the agency. As far as monuments and artistic monument areas are concerned, this competence corresponds to INBAL (CNCPC-INAH, 2014).

In general, a conservation or restoration project of movable property must consist of a comprehensive diagnosis, including materials, previous interventions and context; as well as the proposal, which contains objectives, scope, support, actions to be developed, resource management and chronology. It must be reviewed and authorized by INAH or INBAL, bodies that, in addition, according to their area of competence, will follow up and verify the execution of the work.

3 Technology As a Means of Conservation

According to Erich Fromm it would not be possible to elaborate a concept of technology detached from the social totality in which it takes place, that is, without technology being thought of as a process of totalization (1968). In plain words, technology in late capitalism would be completely imbricated with a basic social engineering responsible for structuring the world of production, the market, the state apparatus, the industrial-military complex, etc.

In this sense, we believe that it would not be possible to accurately measure the impact of new technologies for the preservation of cultural heritage without first analyzing, albeit briefly, this increasingly close articulation between new technologies and the concept of social totality. In the following, we attempt to develop this interpretation, presenting arguments that allow us to justify why we assume this approach to technology and technological society to be the most appropriate.

When we speak of the social engineering that shapes late capitalism we refer mainly to two general principles: 1) the principle of maximum performance or "continuous and unlimited acceleration" of total production and rate of profit; and 2) the principle of reduction of the feasible to the technically possible, that is, the principle that something must be done just because it is technically possible (Fromm, 1968). Governed by these two principles, the technological society raises the instrumental reason of technical means to the condition of guiding end and deontological axiom.

The epistemic consequence of this technological stage is that of an internalization of objectivity (the main asset of the "hard" sciences) by a totalization or "self-externalization of the phenomenon of technique" (Dupuy, 2004). The emergence of an objectivity reduced to its technological self-exteriorization and its closure on itself produces the effect of replication by imitation (as in a hall of mirrors, the technological arsenal, the market dispute and the race for "innovation" are standardized in a single simultaneous movement) and creates an interconnected, ordered, homogeneous, stable world superimposed on the real world (Dupuy, 2004).

Thus, these general principles of the technological era indiscriminately govern both automobile and food production, business and government management, the education and prison systems, the pharmaceutical and entertainment industries.

In the last decade, advances in nanotechnology, cybernetics and AI have been replicated and expanded rapidly from the arms industry (guided missiles, drones and robot dogs) to the information industry (big data), surveillance (facial recognition programs), genetics and pharmaceuticals (cataloging and storage of "data"), education and entertainment (GPT chat, entertainment platforms, virtual tours), urban planning ("smart" cities), the service sector (standardization of teleworking and platform services), and even the service sector (standardization of telework and platform services), education and entertainment (GPT chat, entertainment platforms, virtual tours), urban planning ("smart" cities), the service sector (standardization of teleworking and platform services) and even the "cultural goods" industry (cataloging and preservation), which we are now discussing.

For the most extreme versions of the critique of technology, the development of technological society inhibits any real possibility of deliberation. For it reduces all decisions in any situation to the search for the most efficient technical means to achieve maximum performance, in such a way that this indiscriminate cumulative expansion of the technological into the ecosocial world constitutes a kind of automatic subject (Ellul, 1954).

In other words, the accelerated expansive movement of new technologies, in a certain way, becomes autonomous, that is, it ceases to be a means at the service of an ecosocial end and becomes an end in itself, or even a destiny that escapes all civil control and state planning. On the other hand, possible catastrophic consequences produced by this automatic subject as the destiny of technological society turn out to be as inevitable as unpredictable, thus announcing the promising security market that technologically attends to the possible accidents that the technological order itself offers us (Dupuy, 2004).

Thus arises the branch of "precaution specialists" who, starting from the principle of the "worst possible scenario", will calculate the cost-benefit of the impacts caused by the use of new technologies in the most diverse spheres of ecosocial life, calculating the probabilities of achieving the maximization of performance potentialities in "lesser evil" scenarios (Dupuy, 2004). Although this instrumentalized treatment of the technological problem cannot avoid the scenario of catastrophes to come, it at least trivializes it, making it socially tolerable: "Climate change, ocean pollution, the dangers of nuclear energy or genetic engineering, the unleashing of new epidemics and endemics: humanity will know how to accommodate itself well or find the appropriate technical answers. The catastrophe is so terrible that not only do we not believe that it will happen, even if we have every reason to know that it will happen, but once it has happened, it appears as coming from the normal order of things. Its reality makes it banal. It was not seen as possible before it was realized and, once realized, it is integrated into the 'ontological furniture' of the world to speak the jargon of philosophers" (Dupuy, 2004, p. 154). By simmering its "inevitable" character, it is easier to conclude that, after all, there is not much to expect from the "end of the world" (Dupuy, 2004, p. 154).

On the other hand, one could also take up here the genealogy of Western technological development from an "ontology of war" (Lévinas, 2002) or, more precisely, from the "elective affinities of war and vision" (Arantes, 2019).

For this genealogy, thanks to colonial expansion from the 16th century onwards, technological development is geographically concentrated and temporally accelerated, with the imperialist mandate to "target" (genocide) the populations of two entire continents.

That is to say, this reading defends a "historical nexus" or the original closeness between Western technological development and modern disciplinary and population control devices. The idea of "accumulation by dispossession" (Harvey, 2003) would not only be the interpretative key to the imperialist war of territorial dispute for natural and energy resources that mark the periphery of capitalism in the XXI century, but the common thread that runs through the entire colonial period from the XVI to the XVIII, the imperialist wars of opium and Marathis of the XIX, the "Operation Condor" of the XX and the "war on terrorism" of the XXI. In other words, the notion of "original accumulation" (or accumulation by dispossession) is not only at the origin of capitalist modernity, but is the sine qua non of its maintenance, condemning its periphery to a primary-export enclave. Thus, not only are the classic theses of Luxemburg and Lenin on imperialism confirmed, but also the relevance and relevance of the Latin American theory of dependency.

In this sense, the current stage of the technological race would have been inaugurated with the U.S. intervention in Chile after the 1973 military coup and the consequent experimental implementation of "authoritarian neoliberalism", at which time its population fell "under the spotlight" of new social programs to "combat poverty".

We explain: while privatizing the country's infrastructure, health services, education and pension system, the Chicago School elaborates a detailed mapping of poverty in Chile, combining its idea-basis of "human capital" with that of "public-targeting" or potential candidate of the new targeted cash transfer programs or "targeting welfare spending" (Lavinas, 2013).

It is this formula of the "Chicago boys" in Pinochet's Chile - of a population subjected to a "total war" and, at the same time, considered a target of transfer policies - that will mark the beginning of neoliberal governmentality as an authoritarian or securitarian-welfare model (Klein, 2007).

In other words, the idea of "target-population" assumes this duplicity of being at the same time attacked in its most basic social rights, violated, subjugated, but also protected, assisted, protected by cash transfers. Thus, labor is "trained" in the instability, precariousness and under-remuneration of the new neoliberal market of goods and services and, on the other hand, the function-utility of the average minimum state taxpayer is maximized.

But at the end of the day, a society of population targets (targetings) catalogued and placed under a geolocalized public policy of damage containment also appears as the weakest and most exposed side of an era of successive wars for natural resources, energy and territory, humanitarian crises, pandemics, climatic catastrophes, etc.

What does such a dystopian - and frankly conspiratorial and paranoid for some - scenario have to do with the incautious and harmless new industry of cultural heritage preservation? Faced with this question, we will respond by assuming the role of the "precautionary specialists", making a very brief reflection on some of its possible risks.

This year, the European Union proposed the HYPERION project for the use of AI for the preservation of its tangible cultural heritage (archaeological sites, sculptural and architectural heritage, cultural heritage, etc.). With a relatively modest initial investment of 6 million euros.

The project is to use innovative tools in order to "better cope with future catastrophes" (such as extreme weather conditions, weather ravages and intense geological events) by employing AI to "automatically identify conditions using ground-based multispectral/hyperspectral image analysis techniques" with the help of sensors, satellite services, drones and "community engagement tools" (HYPERION, 2024).

This last item consists of downloading a mobile application with which "residents" and "visitors" can photograph signs of damage to archaeological, sculptural and architectural sites that will be shared "live" to a world map that records, cross-references and stores deterioration data for more accurate and effective diagnosis and intervention.

In our continent, all archaeological sites and cultural enclaves are part of a complex of tourist assets managed by large multinational chains and patrolled by private security companies (paramilitaries) and the armed forces. On the other

hand, they are located in regions with large natural and energy reserves, besieged by extractive companies, by narco-paramilitarism and now also by the project of southward expansion of the maquila industry.

In other words, the use of AI in the geolocalized mapping and cataloguing of these regions could only be valued in its real dimension if we understand that the service of maintaining the material cultural heritage is imbricated in a much broader complex of tourism assets, extractivism, drug trafficking and militarization of the territories, in relation to which local populations find themselves increasingly besieged if not displaced, living in a kind of permanent "domiciliary exile" (Rabinovich, 2015).

Therefore, we consider that simply transferring this type of technology to our territories could represent a threat to native peoples, in addition to implying the absence of any form of citizen control. This is also why the meaning of "community participation" according to the EU standard (HYPERION, 2024) is particularly suggestive.

"Community participation" is, in this case, to be the bearer of a cell phone with a camera and to cede the copyrights of your shots free of charge so that they can be stored by a private technology company. In other words, the degree of "participation" and citizen control in the process of management and preservation of cultural heritage is limited to being the object of the same extractivism of images that moves the current Big-data market. Returning to the old Marxist jargon, it would be the same specular device of passive contemplation typical of the rectification mechanism at the core of the social engineering of late capitalism (Debord,). It should be specified that this is not a Platonic critique of the image - as if it had an essentially fetishistic character of its own - but a political and military use of the social totality and of the political subject that could give it a critical and transforming use (Jappe, 2004). This is an "extractive" use of the image by the Big-data that autonomizes and superimposes it on the real world, an autonomy that makes possible new modalities of manipulative prestidigitation of information and inaugurates a new era - of "post-truth" and "hybrid war" (Gonçalves, 2020) -, which offers us as antidotes the imaginary evils that it itself produces, while accumulating behind it wars, humanitarian crises and a real climate catastrophe.

In the same sense, transforming our intangible cultural heritage into an asset stored in digital capsules uploaded to a "cloud" by technology companies carries an even more serious risk. It is enough to warn us to keep in mind the counter-insurgent military use of North American ethnography in Latin America in the 60s and 70s and in the most recent petro-wars of the 90s (Lopez Rivas, 2013).

We conclude that before studying the benefits of applying new technologies to the preservation of our tangible and intangible heritage, we should first ensure the full rights of the native communities to their territories, to their self-determination, to their uses and customs and to their own forms of self-organization and political deliberation, since this is the only and authentic source of preservation of our cultural richness and diversity (languages, oral traditions, literatures, rituals, dances, cultivation of the land, native seeds, medicine, handicrafts, cooking, self-care, etc.).

4 Application of New Technologies in the Conservation of Cultural and Artistic Heritage

Cultural heritage is of inestimable value; it is considered the legacy of humanity, encompassing archeological sites, monuments, traditions, artistic expressions, among others, which form the basis of cultural identity and are a fundamental factor for social and economic development.

The application of digital technologies in the different areas of human knowledge has generated a considerable increase in the development of digital collections in the cultural heritage sector, which has driven technological development to automate various processes associated with their organization, preservation, study and dissemination.

In this context, new technologies, and in particular artificial intelligence (AI), emerge as a means for the management and conservation of cultural heritage; offering different tools for its preservation, promotion and accessibility (González, 2022). In particular, Artificial Intelligence can be perceived as a field of computer science constituted by systems that emulate human intelligence (such as learning, reasoning and perception) in the development of activities. These systems are programmed with different functions for the perception of the environment, knowledge-based reasoning, data processing for the generation of information, and decision making to achieve a given objective (Government of Spain, 2023).

In turn, the European Parliament (2020) defines Artificial Intelligence as the ability of a machine to present the same capabilities as human beings, such as reasoning, learning, creativity and the ability to plan; it allows technological systems to be complemented by the use of devices to collect data from the environment (sensors, cameras, among others), process the data and respond to them.

Artificial Intelligence, in the context of the conservation of cultural and artistic heritage, has as key uses, the analysis of large amounts of data, machine learning algorithms, for example, can be used in the analysis of data from archaeological excavations, in the documentation of museum collections, digitization of large data sets of historical and cultural heritage, among other functions; however, it is important to control the training data, since the similarity of digital models with reality depends on it.
Significant advances in AI in relation to the heritage, cultural and artistic sector have been mainly oriented towards the following:

- Visualization and management of collections in digital platforms.
- Optimization of search mechanisms applied to the discovery of important pieces of information.
- Addition of usability services such as machine translation.
- Audience analysis.
- Knowledge extraction based on representations of cultural heritage objects.
- Enrichment of collections through quality metadata.

The algorithms developed to address the items described above are mainly based on Machine Learning (ML), an area of Artificial Intelligence that groups a set of techniques to increase the functionality of a computational method for a specific task through a training period, i.e., through iterative data processing that increases its efficiency.

The correct use of Artificial Intelligence and derived technologies allows to discover patterns and relationships, to provide new perspectives through data analysis, and to identify and classify objects to be considered as part of the cultural-artistic heritage.

4.1 tangible cultural and artistic heritage

Machine learning algorithms are trained to recognize objects from their particular characteristics, thereby supporting cultural heritage experts in the classification and detection of the background of physical pieces that can be automatically identified and classified as part of a specific art collection, of a particular culture, or, if not considered as part of cultural-artistic heritage. Based on this, we present the following classification of intangible cultural and artistic heritage:

- Archaeological Heritage: Archaeological sites, monumental zones, and objects associated with pre-Hispanic cultures. Examples include Teotihuacan, Chichen Itza, and pre-Columbian artifacts.
- Historical Heritage: Properties and objects dating from after the Spanish conquest, such as colonial buildings, churches, convents, historical documents and furniture.
- Artistic Heritage: Works of art created after colonial times that have aesthetic value, such as paintings, sculptures, and applied arts.
- Paleontological Heritage: Fossil remains that represent the history of life on Earth, such as dinosaur bones, fossilized plants and other prehistoric remains.

As examples of the use of AI in cultural and artistic heritage, we can identify the use of neural networks in the generation of 3D (three-dimensional) representations from the analysis of multiple photographs with different characteristics (Figure 1). Some experimental uses have made it possible to recreate complete scenes in monuments and buildings that, instead of being scanned, were reconstructed from the interpolation of multiple images that visitors posted on social networks, as is the case of the Brandenburg Gate in Berlin and the Trevi Fountain in Rome (Martin-Brualla, et al. 2021).

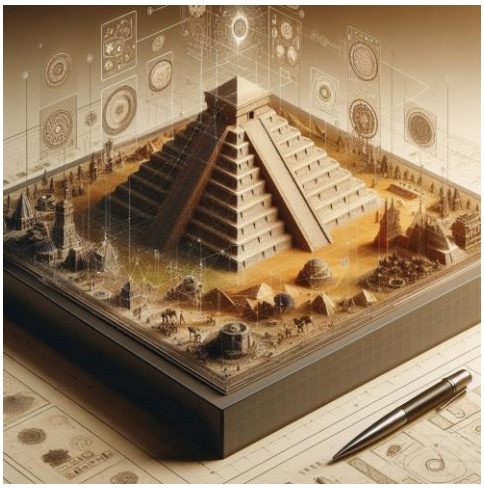


Figure 1. Representative image of 3D model generation (Bing, 2024).

With the use of AI in the documentary development of cultural and artistic heritage, the digital volume of information generated during the capture phases and during the construction of the database with information such as photos, images, text, videos, among others, has increased, popularizing the use of Deep Learning techniques. As a complement to this action, semantic information is automatically integrated to the models (figure 2).

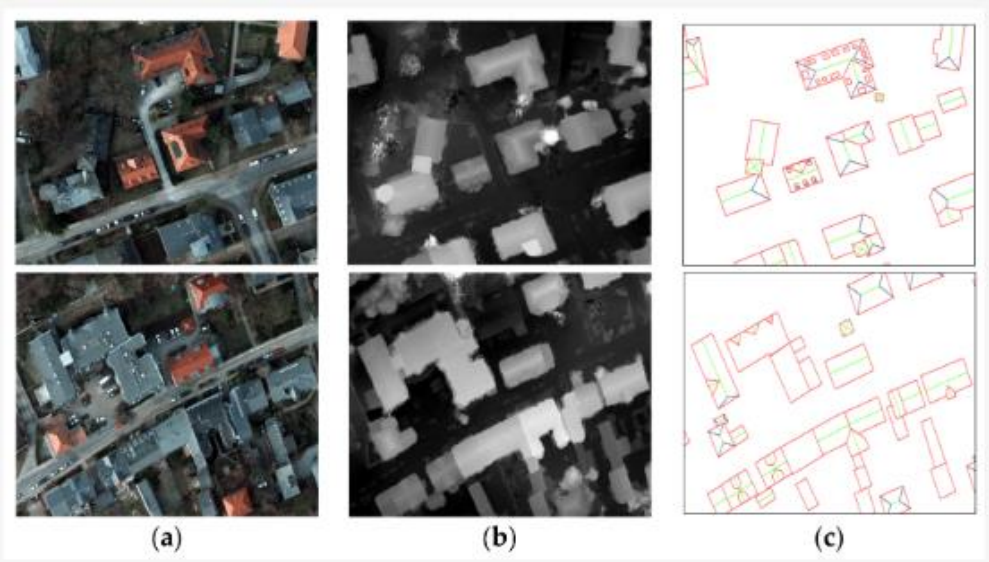


Figure 2. Training data sample: a) RGB images;(b) normalized digital surface models; c) linear elements of roofs (Alidoost, Arefi & Tombari, 2019).

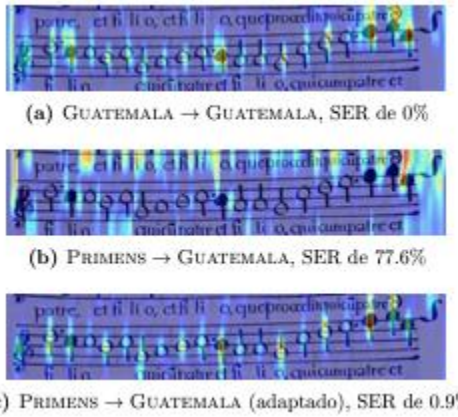
Another way to apply AI in the preservation of cultural and artistic heritage is through computational simulation, since it is a strategy for preventive conservation of objects, by carrying out the analysis of variables that affect deterioration and suggesting actions to reduce the physical impact on these objects. For example, according to Leissler, Kilian, & Simon (2015). the following areas can be studied in relation to the use of AI in the restoration and prevention of deterioration of tangible cultural and artistic heritage:

- Humidity fluctuations
- Temperature variation in the context of targets, e.g., historic buildings.
- Suggest conditioning actions
- Suggest sustainable regulation plans to avoid damage to artistic and heritage objects.

- Transfer of information from mathematical models during the simulation of the behavior of conditions inside and outside the targets.
- Among others.

In the particular case of the restoration, recovery and backup of textual sources such as books, parchments and physical documents, digitization is an active strategy in the dissemination of collections in the cultural heritage sector, with the additional generation of metadata to identify areas of interest in the public, academic and research sectors. The digitization of text documents, for example, is complemented by optical recognition systems that produce a transcription from the characters present in the images.

Automated transcription tools are combined with AI techniques to automatically translate and disseminate content in different languages than the original script (CETSO, n.d.). For example, one has the transcription of old sheet music, which must cope with erasures and deterioration marks on the documents, as well as the lack of a standardized notation (Baró, Rizo, Calvo-Zaragoza, & Pertusa (2020.)



(a) Guatemala → Guatemala, SER de 0%

(b) Primens → Guatemala, SER de 77.6%

(c) Primens → Guatemala (adaptado), SER de 0.9%

Activation maps in the Guatemala test using the OMR model trained with scores of: (a) Guatemala, (b) Primens, and (c) Primens adapted to images of Guatemala (Rosello, 2024).

The digitization of objects has pushed institutions towards the development of activities that generate collections from the use of algorithms that have allowed the link between AI and cultural and artistic heritage, according to the report generated by the Working Group of the Europeana Association (Markus, Smith, & Taylor (2023).

Today, there is a need for investment in digitization, storage and design and implementation of visualization platforms for collections that otherwise would not have timely access. AI developments require the creation of appropriate data sets, preprocessed, structured in a database and properly annotated to train models automatically, i.e. by adding labels that are relevant, sufficient, consistent and of quality.

Some barriers for these AI developments to flourish in this sector will have to do with the scarcity of properly processed data, lack of sufficient hardware resources, limited time for project implementation, and the absence of specialists with technical skills and sensitivity to collection materials in current teams.

4.2 intangible cultural and artistic heritage

The application of AI in the conservation and restoration of cultural and artistic heritage has emerged as an innovative and effective approach. This is based on analyses where digital techniques are used for the preservation of both tangible and intangible cultural heritage, highlighting its impact on sustainability and accessibility, maintaining the identity and traditions of communities. Therefore, technology plays a crucial role in this process, facilitating the documentation, preservation and dissemination of various cultural manifestations. This section explores how technology is applied in different areas of intangible cultural heritage, such as those included below:
Traditions and oral expressions: Includes legends, tales, and myths that are transmitted from generation to generation.
Social practices, rituals and festive events: Such as traditional festivals, religious rituals, and community celebrations.

Knowledge and uses related to nature and the universe: Refers to traditional knowledge, such as herbal medicine and agricultural practices.
Traditional handicraft techniques: Includes handicraft production techniques, such as textiles, ceramics, and other handicrafts.
Documentary Heritage: This includes historical archives, ancient documents, manuscripts, and any documentary material of historical, cultural, or artistic value.
Underwater Cultural Heritage: Includes all cultural property found underwater, such as shipwrecks, submerged ruins and other archaeological remains.

These traditions, oral expressions, rituals and knowledge are fundamental to the identity of communities. The preservation of these elements is crucial, as they are at constant risk of disappearing due to factors such as globalization and climate change. According to Nasarre (2021) and the Organization of Ibero-American States (2022), digitization not only allows documenting these traditions, but also democratizing their access, making it easier for more people to connect with their cultural legacy.

It should be noted that the digitization of cultural heritage has revolutionized conservation techniques, among which the following stand out:

- Photogrammetry and 3D Scanning: which is a technique that allows precise digital replicas of objects and heritage structures, which is essential to diagnose and plan restorations without compromising the originals, Lozano (2010), as well as the creation of 3D models of handicraft products, which allows preserving the knowledge and traditional method of certain activities, Similarly, these tools allow documenting archaeological sites underwater without causing physical damage, with the use of 3D scanning and underwater drones or regular monitoring thanks to drone flights programmed to detect changes in the terrain or structures, Metaverso, (2023), IDC Drones, (2022).
- Augmented Reality (AR): Rodriguez (2017), refers that this tool is interactive as it allows users to visualize how the works were in their original state and thus enhances the understanding and appreciation of heritage, also; the documentation of rituals and festive events through video and digital photography provides a visual record that can be used for education and cultural promotion, EVE Museography (2022)
- Digital Platforms: which consist of web or mobile applications that facilitate access to information on cultural heritage, allowing users to explore cultural routes as explained in the Organization of Ibero-American States (2022), in addition, online platforms facilitate the teaching of traditional techniques through tutorials and virtual courses, where continuity is promoted.
- Multimedia platforms: technologies allow recording and archiving oral traditions, ensuring that the stories and legends of communities are not lost over time, this digitization of narratives encourages the activity of preserving the cultural context and facilitating access to new generations. Projects such as interactive digital archives allow users to explore these traditions in a dynamic way, according to Telefónica, (2022).
- Geographic information technologies (GIT): They help document traditional environmental knowledge and map sustainable practices and traditional uses of natural resources, helping to conserve both the knowledge and the natural environment that sustains it, Organization of Ibero-American States, ((2022).
- Databases: digitization of historical archives, manuscripts and documents can be scanned and stored in databases, facilitating academic research by providing remote access to materials.

The restoration with the new technological tools has taken a crucial step in the analysis of works of art, with which AI is present with applications such as pattern recognition, where deterioration is identified and at the same time help conservators to anticipate problems that can become severe damage, on the other hand the virtual restoration with AI can simulate restoration processes that allow to evaluate different approaches before applying physical methods.

Despite the significant benefits that may exist with technology in this disciplinary field and heritage care activities, the existence of challenges and opportunities are latent, given that the digital divide on internet access has increased, there are still communities with technological limitations that prevent full access to digitized heritage and even long-term preservation, has given a rapid technological evolution that has raised questions about the sustainability of digital platforms for these activities.

However, collaboration between cultural and technological institutions and local communities will be key to ensuring a sustainable future for intangible and tangible cultural heritage. Integrating technology into the preservation of intangible cultural and artistic heritage not only helps conserve these vital elements of cultural identity, but also promotes their dissemination and appreciation in a global context. As digital technologies advance, it is critical to continue to explore new ways to protect and celebrate our collective heritage.

5 Conclusions

In conclusion, it is necessary to carry out a reflection in cultural institutions towards the expansion of access to cultural and scientific heritage that, if it were not for digital platforms, such access would be limited. From the perspective of access to digitization, it is appropriate to reflect critically on the dependence on a computer language that could restrict the opportunity for consultation and exploration of cultural heritage objects, however, this proposal expands access not only in person, but also digitally. Additionally, it becomes urgent to incorporate in this discussion a usability perspective that enables the participation of audiences from their bodily and perceptual singularities. This approach is another area in which AI tools can offer valuable contributions, while at the same time they can enhance other senses of diversity, as is the case with automatic translation, which enables dynamic interaction between people and cultural objects of different languages that coexist in the same country.

Given the lack of resources to develop technology, a convenient route is the application of AI algorithms from nearby problems that, through transfer learning, can specialize in problems specific to specific collections using a smaller amount of data and resources.

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