FAMILY AND SOCIETY JOURNAL
International Biannual Journal
refereed Issued in three languages
EISSN: 2602-6716 ISSN: 2392-5337
https://www.asjp.cerist.dz/en/PresentationRevue/236

Volume: 14 / Issue: 01(28) / 2026	Received: 17 / 04 / 2026	Accepted: 18 / 05 / 2026	Published: 30 / 06 / 2026	Pages:93 – 108

Digital Preservation of Cultural Heritage Amid the Artificial Intelligence Revolution: Opportunities and Challenges

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Abstract:

Cultural heritage, in all its types and forms, constitutes a source of pride and dignity for nations. It represents a collective identity and memory that preserves and transmits a nation's culture, bears witness to its emergence, indicates its achievements, and serves as a link between generations. Amid contemporary technological developments and the rapid transformations experienced by the cultural sector as a natural response to changes in the digital environment, cultural heritage has shifted from static holdings to interactive platforms for participation in the public sphere through the services provided by artificial intelligence, such as virtual and augmented reality, virtual restoration, restoration of images and mosaics, and natural language processing for translating and analyzing historical texts and detecting artistic forgery. All these functions enabled by artificial intelligence in the service of cultural heritage are capable of contributing effectively to its preservation and sustainability, as the qualitative transformation they have produced in terms of speed, quality, abundance, flexibility, convenience, and enjoyment cannot be ignored.

Keywords: Cultural Heritage; Digital Preservation; Artificial Intelligence.

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Introduction:

The importance and status of cultural heritage render its destruction or disappearance as a result of negative practices tantamount to impoverishing and harming the heritage of all peoples of the world. It is therefore imperative to rescue it and work toward its preservation by activating means capable of safeguarding it over the long term.

The integration of artificial intelligence into cultural heritage sectors represents a qualitative and more attractive shift. The digitization of cultural heritage is no longer limited to the creation of digital archives. Rather, three-dimensional scanning now creates interactive virtual experiences that enhance the engagement of people from various parts of the world, transforming cultural heritage from static possessions into interactive platforms for participation in the public sphere. AI has also assisted in analyzing and interpreting vast quantities of cultural data such as historical documents, artworks, and archaeological discoveries, enabling researchers to uncover new connections and insights about the past, as well as patterns, relationships, and perspectives that may previously have been overlooked.

AI is also used to analyze the condition of buildings, sculptures, and historical artworks in the field of preserving and restoring cultural heritage sites and artifacts, detecting signs of deterioration, damage, or structural instability, and using this information to develop effective strategies. Other possible uses of AI include natural language processing for translating and analyzing historical texts through the interpretation and analysis of texts written in ancient or obscure languages, allowing the acquisition of new insights into distant cultures and historical periods. In addition, AI can improve the organization and presentation of cultural heritage exhibitions and collections, and assist museums and cultural institutions in developing the visitor experience and making it immersive and interactive.

Thus, all these functions enabled by AI in the service of cultural heritage can contribute effectively to its preservation and sustainability, since the qualitative transformation they have produced in terms of speed, quality, abundance, flexibility, convenience, and enjoyment cannot be ignored.

Through this article, we have sought to highlight the most important strategies that can be relied upon in protecting cultural heritage, whether traditional approaches such as remedial methods or modern approaches, focusing in particular on AI applications and the challenges that may hinder their optimal implementation.

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I. Defining Concepts:

1- Concept of Heritage:

Heritage, in its simplest sense, is defined as the cumulative legacy left by preceding generations to subsequent ones. It represents the continuation of the forebears through their successors, or what ancestors leave behind for descendants to draw upon. It is the inheritance transmitted from forefathers, consisting of items possessing value and authentic characteristics **(Al-Hayaji, (2016), p.89)**. It also encompasses the collection of ideas, patterns, and cultural customs transmitted from one generation to another in any form **(Nasser, (2024), p.15)**, whether through architecture, writing, engraving, needs, or artifacts. In other words, it is **"**the product of a people or a group living in a particular place.**"**

From a scientific perspective, it is an autonomous cultural discipline concerned with a specific sector of culture, illuminating it from archaeological, historical, geographical, social, and psychological perspectives. It addresses all that remains on earth of civilizational indicators and archaeological remnants dating back to past eras **(Mohamed, (2023), p. 46).**

Material heritage includes all tangible elements such as buildings, historical sites, monuments, and artifacts that are worthy of protection and optimal preservation for future generations. It consists of the remains left by ancestors that have endured, including religious structures such as temples, tombs, and mosques, as well as military and civil buildings such as fortresses, palaces, castles, baths, dams, towers, and walls, which archaeologists refer to as immovable antiquities. In addition, it includes tools used by ancestors in their daily lives, referred to by archaeologists as movable antiquities. Natural heritage is also considered an important part of cultural heritage, referring to geological formations, natural sites, and areas of natural beauty that serve as habitats for human, animal, and plant species. Accordingly, sea coasts, sand dunes, mountain ranges, inlets, and even sheep, wild tigers, and black panthers all constitute part of heritage that must be preserved as a heritage of humanity at risk of extinction **(Mohamed, (2023), p.46).**

Intangible heritage encompasses the practices, representations, expressions, knowledge, and skills, along with the instruments, objects, artifacts, and cultural spaces related to them, which communities, groups, and occasionally individuals acknowledge as integral to their cultural heritage. This form of cultural heritage is passed down through generations and is continually reinterpreted by communities in relation to their surroundings and their interactions with nature and historical contexts. It cultivates a sense of identity and continuity while promoting appreciation for cultural diversity and human creativity **(United Nations Educational,**

Scientific and Cultural Organization (2003), p.04). In accordance with this definition, intangible cultural heritage is particularly evident in several areas**:**

- ✓ traditions and oral expressions, with language serving as a medium for intangible cultural heritage;
- ✓ performing arts and performance traditions;
- ✓ social practices, rituals, and celebratory events;
- ✓ skills linked to traditional craftsmanship.

The term intangible heritage had limited usage and was primarily confined to a small cohort of specialists. Its broader application is mainly attributed to the UNESCO Convention ratified in 2003.

2- Digital Heritage:

Digital heritage refers to the preservation of tangible and intangible human heritage through the most advanced and diverse technological techniques, making it accessible to all via the internet in line with developments in information technology **(Al-Ghafri, & Khadr (2024) ,p.08).** Digital heritage takes digital forms analogous to many traditional forms of cultural heritage, in addition to digital forms corresponding to analog materials. It also assumes the form of social media content, virtual reality materials, augmented reality materials, digital art, web archives, and many other materials.

The digitization of heritage refers to the processes aimed at making it electronically accessible. It is a procedural operation for converting intellectual content available through a traditional physical medium into a digital form **(Mohamed, (2023), p.47).**

3- Digital Preservation:

Digital preservation denotes a range of coordinated efforts essential for guaranteeing ongoing access to digital resources for as long as necessary. It includes all actions required to preserve access to digital content despite the challenges posed by media deterioration or shifts in technology and organizational structures **(United Nations Educational, Scientific and Cultural Organization (2021), p.08).** This encompasses strategies and protocols focused on the protection and sustainability of both tangible and intangible cultural heritage, which involves identifying such heritage, its digitization, research activities associated with it, safeguarding, promotion, presentation, transmission, and the revitalization of its various facets **(United Nations Educational, Scientific and Cultural Organization (2003), p04).** Digital preservation guarantees enduring access to digital information across different timelines, technologies, and shifts in meaning. It provides lasting advantages that can be social

(evidence for governance), cultural (national identity), and economic (utilization, re-utilization, and innovation).

4- Artificial Intelligence:

AI is the field that seeks to understand the nature of human intelligence and to simulate it through the design of computer programs that accurately and intelligently imitate human actions and behavior **(Sabeq, Amira (2024), p. 09).** It is the science and engineering of computer programs capable of simulating human intelligence, "the science and engineering of making intelligent machines." **(Al-Touzani, Nouredine (2024), p. 03).**

II. The Importance of Safeguarding Cultural Heritage:

The necessity of protecting and preserving cultural heritage arises from several fundamental considerations, including **(Delliou,foudil (2020), p.262):**

- Heritage constitutes the identity, authenticity, and distinctiveness of individuals, and serves as a protective element against dissolution and assimilation into others.
- Cultural holdings possess a unique and nonrenewable nature; therefore, damaging, looting, or destroying them represents an irreversible loss.
- These holdings originate from previous social contexts, and if they are not preserved, they will disappear and no replicas will be generated.
- Heritage serves as a means of recognizing the diversity of peoples.
- It constitutes an essential resource for scientific research concerned with investigating the history, civilization, and culture of peoples.

III. Values and Uses of Cultural Heritage:

(Delliou, foudil (2020), p.262-263):

- Utilitarian value: through the use of heritage holdings to meet material, cognitive, or recreational needs.
- Formal value: such as artistic and aesthetic characteristics.
- Communicative value: whereby cultural heritage serves as a means of communication between generations and is transmitted and circulated.
- Spiritual value: cultural heritage carries spiritual connotations and sentiments.
- Civilizational and cultural value: cultural heritage stands as a witness to what our fathers and ancestors experienced, and thus represents the identity and history of the nation.

IV. Risks Threatening the Security and Sustainability of Cultural Heritage:

Cultural heritage, in its various manifestations, encounters a multitude of threats stemming from both natural and anthropogenic sources that jeopardize its preservation and authenticity, rendering it vulnerable to damage and alteration The principal threats include **(Al-Hayaji, Yasser (2016), p.91) :**

- Natural factors: these are elements arising from the inherent characteristics of the natural environment, including solar radiation, climatic conditions such as temperature, winds, and precipitation, as well as natural calamities like floods, earthquakes, lightning strikes, and volcanic eruptions.
- Human factors: these encompass human intrusions into cultural heritage locations, which have resulted in significant detriments due to neglect, demolition, acts of vandalism, theft, inadequate restoration efforts, armed conflicts, urban development activities, and various development initiatives.
- Biological factors: living organisms of various kinds, whether visible such as harmful animals, reptiles, insects, and rodents, or invisible such as fungi, bacteria, and microorganisms, cause different forms of damage, including stains, chromatic distortions, perforations, and erosion.

V. Mechanisms for the Dissemination and Consolidation of Cultural Heritage (Between Traditional and Contemporary):

Mechanisms for disseminating and preserving cultural heritage have multiplied and intertwined between what is old "traditional" and contemporary "technological and digital". We have attempted to summarize them as follows**:**

1- Family Socialization as One of the Most Important Educational Strategies for Consolidating the Features of Cultural Heritage:

The family is considered the primary social institution concerned with transmitting culture and education to children. It constitutes an organized social and cultural environment, as well as a fundamental framework and setting for learning, and represents one of the most important means of education and socialization. It contributes to the psychological and social growth and development of the individual, enabling them to become a social personality that functions according to the norms of their primary and reference group. The family is a primary source for

acquiring knowledge, skills, habits, attitudes, and values that seek to adapt the individual to their social culture **(El-Hussein, Azzi (2013), p.47)**. The family therefore plays a significant role in raising children's awareness of the importance of cultural heritage by instilling societal values and practicing its customs in various gatherings and occasions, which constitute opportunities to highlight cultural heritage and introduce it to children. It also guides them on how to engage with its various elements, whether by familiarizing them with these elements or by developing their awareness of appropriate behaviors for preserving and transmitting them from one generation to another.

2- Education and Curriculum Planning:

It can be argued that satisfying the cognitive dimension of the individual constitutes a fundamental variable for activating mechanisms for protecting tangible and intangible cultural heritage, since most violations and infringements that cause damage to heritage stem from individuals' ignorance or indifference toward the value of that heritage. Therefore, it has become imperative for all educational and pedagogical institutions to develop effective plans and strategies within their curricula and educational programs. The school, as a secondary social institution concerned with the task of socializing individuals, plays a fundamental role in enabling the individual to acquire an adequate level of education and upbringing. It seeks to develop intellectual, physical, and social capacities, in addition to its contribution to the educational dimension related to teaching members of the new generation the patterns of behavior they adopt in different social situations based on what society expects of them. Consequently, the school plays a distinctive role in developing children's awareness of local cultures and in teaching them through the incorporation of such content into educational curricula.

Among the educational activities that contribute to developing learners' cultural heritage are **(Al-Askari, Sulaiman, (2018), p.62):**

- **Preparing research projects:** Learners are asked to investigate a topic related to cultural heritage. Through this activity, they collect the necessary information from various knowledge sources about the topic, strive to analyze, organize, and formulate it, and produce conclusions that present their perspective on the value of cultural heritage and the means of protecting and developing it.
- **Discussions:** Discussions may be conducted in classrooms with the aim of providing learners with opportunities to express their views on issues related to

cultural heritage and ways of protecting it, and to exchange ideas and information about forms of cultural heritage in each region of the country.

- **Artistic and creative activities:** Students need to complete artistic or creative tasks through either drawing, photography, or by writing essays about different cultural heritage forms. Students who participate in these activities and other similar activities will learn to value cultural heritage while they develop their artistic and aesthetic abilities.
- **Visits to museums and archaeological sites:** Students can experience direct contact with physical cultural heritage through educational trips which schools should organize to help students develop heritage appreciation and preservation understanding. The trips create lasting memories. These help students remember their learning experiences while teaching them to protect important sites.
- **Role playing and dramatization:** Students must perform theatrical plays which demand them to assume historical character roles while showing cultural heritage situations through their performances. Students learn historical subjects better through role playing and dramatization while they develop positive views about cultural heritage, which makes them proud of their heritage, leading to personal connection and acceptance.

3- Media:

Media, in its various forms "public, private, general, specialized, print, audio, audiovisual, digital...", seeks, through its diverse functions, to protect and preserve both tangible and intangible cultural heritage by achieving a set of essential roles. It contributes to the dissemination of cultures by introducing the tangible and intangible cultural heritage of a region, such as highlighting archaeological sites and the history of ancient civilizations, which in turn enhances national belonging, fosters pride in the homeland, and encourages its preservation **(Kafi, Moustafa (2015), p.90)**. It also plays a significant role in instilling values related to safeguarding traditional crafts and industries.

The role played by media across different channels in covering exhibition activities and visual arts in all their fields cannot be denied. Media also provides opportunities for artists or artisans to present their artistic works, which are based on artistic trends and schools with historical backgrounds reflecting a deeply rooted visual culture **(Abdullah, May (N.d), p.04-05).** Furthermore, media encourages openness to the cultures and civilizations of other peoples by considering culture an important domain for cultural interaction among societies, through exposure to patterns of individual lifestyles, social structures, and civilizational and cultural contexts in other countries for the purposes of knowledge and learning **(Hijab, Mouhamed (2003), page 17).**

Among the media activities that contribute to consolidating and promoting cultural heritage are the following **(Asbar Reports Series (2024), page 16):**

- ✓ Producing documentary and historical (informational) content through the creation of documentary series that explore history and prominent cultural landmarks and narrate their historical stories, which can be broadcast locally and internationally.
- ✓ Producing awareness programs by hosting experts and specialists to provide advice and guidance to audiences on how to safeguard heritage and contribute to its circulation and promotion.
- ✓ Intensifying specialized media coverage through the establishment of cultural news sections and segments dedicated to cultural heritage.
- ✓ Launching concise and engaging awareness-oriented media campaigns.

4-Modern Information Technologies and Artificial Intelligence Applications:

Digital and information technologies accompanying the technological revolution have become among the fundamental variables that increase the strength and impact of communication messages, enhance interactions, and accelerate the exchange of information and messages among individuals across various service sectors, including the cultural sector.

Effective control of information technology, adaptive technologies, and the specificity of digitizing cultural heritage in virtual space contributes to strengthening the sustainable protection and valorization of cultural assets through efficient methods that align with scientific and knowledge-based transformations embodied by technology within a smart knowledge society. The promotion of tangible and intangible cultural heritage across various digital platforms contributes to the following **(Aida Moustfaoui & Zakaria Herkass (2020), p.08):**

- Eliminating limitations related to copies, as digitization enables the dissemination of information to every seeker and beneficiary.
- Moving beyond a purely local character, particularly with the possibility of including or classifying cultural reserves within shared human cultural heritage.
- Safeguarding cultural heritage from disappearance, especially manuscripts and paper documents.
- Ensuring optimal control, management, and administration of heritage in a structured manner.

AI applications have opened new and innovative horizons for methods of safeguarding cultural heritage, bringing about a revolution in the documentation, digitization, and promotion of heritage assets, including**:**

1) **Geographic Information Systems and three-dimensional modeling**:

Photogrammetry is a technique that uses a series of widely overlapping images for three-dimensional modeling of cultural heritage, particularly historical buildings. This independent method relies on triangulation from two or more images to digitally reconstruct the image, and it is highly useful for capturing, editing, analyzing, and representing spatial reference data for archaeological sites and historical structures. Geographic information systems enable a more comprehensive approach to heritage preservation and facilitate the development of virtual historical collections and archives, while recognizing the integration of heritage sites with the surrounding landscapes **(Attia, Alya (2023), p.47).**

2) **Virtual reality applications:**

The application of virtual reality technology provides users with an impressive experience for exploring a virtual scene in contrast to traditional methods. Users can effectively enter and interact with a three-dimensional environment, which enhances the sense of being part of the virtual space. Various navigation models are employed to improve the sense of presence, such as walking or flying within a three-dimensional space.

3) **Virtual reality and augmented reality technologies have provided new ways for visitors to explore and experience artifacts in museums.**

Virtual reality technologies (VR) allow remote or virtual tours that enable visitors from distant locations to view artifacts. With the assistance of virtual reality and augmented reality technologies, museum visitors can enjoy an interactive experience with artifacts, as they can observe them from multiple angles or enlarge them for closer examination. In addition, these technologies enable the reconstruction of historical environments and bring artifacts to life. Visitors can explore virtual reconstructions of ancient cities, interact with three-dimensional models of artifacts, and experience historical events through immersive simulation processes **(Al-Ghafri Mouhamed & Khadr Ahmed (2024), p. 06)**

4) **Preservation of cultural heritage sites:**

Studies demonstrate that integrating remote sensing datasets with geographic factors and economic indicators to enhance monitoring and early warning mechanisms, by prioritizing the use of big data for surveillance purposes, can contribute to the development of sustainable strategies for protecting architectural heritage amid the challenges posed by urbanization. This also enhances the retrieval of contextual information in risk management through the integration of virtual

reality (VR) data and Heritage Building Information Modeling (**HBIM) (Attia, Alya (2023), p. 48).**

5) Analysis and Restoration:

Heritage preservation benefits from new sensing technology developments which support the creation of various data models for structural health monitoring. AI systems now possess the ability to capture and analyze high resolution images of manuscripts and paintings, and ancient sculptures, which helps reveal concealed details and recover lost textual content. The system performs restoration work with exactness. This leads to time savings and resource conservation. AI systems perform detailed image analysis to detect patterns which they use for predicting missing details (**Al-Ghafri, Mouhamed & Khadr, Ahmed (2024), page 06).**

8) Language Processing:

Intelligent translation tools enable people to comprehend and maintain their cultural heritage while they translate between ancient and modern languages, and researchers can analyze old manuscripts through text pattern recognition, which helps them understand historical events and developments better. Museums now use neural linguistic programming technology (NLP) in their customer service departments to understand visitor questions and provide automated answers. AI systems process customer messages to extract essential information.

They use this for creating personalized response messages. The system allows customer service teams to deliver fast and precise responses which results in better visitor experiences.

9) Storytelling:

The feature offers complete explanations about artworks and archaeological artifacts together with their historical background information. The system enables people who have vision problems or cannot speak to access cultural heritage materials **(Attia, Alya (2023), p. 48).**

Consequently, AI technologies contribute to the establishment of museums and cultural heritage centers, the documentation of oral and written heritage, the recording of handicrafts, the organization of festivals and promotional events for cultural heritage and traditional arts, and the provision of educational courses for preserving heritage in more creative and aesthetically refined ways **(Al-Ghafri Mouhamed & Khadr Ahmed (2024), p. 06).**

- **Advantages and Disadvantages of Using AI in Preserving Cultural Heritage:**

The most significant advantages and disadvantages of the use of AI in safeguarding cultural heritage can be summarized in the points presented in the following table:

Use of AI Techniques in Preserving Cultural Heritage			
Negatives		Positives	
Efficiency	Processing vast quantities of data in a short time, which saves effort and time.	Data privacy	Raises concerns about information security due to the possibility of breaches and digital damage.
Dissemination	Moving beyond a local scope to a global reach.	Authenticity	Information may be subject to distortion due to widespread circulation, lack of control over the product, or misuse.
Cost	Reduces labor costs .	Interactivity	Digital copies available via the internet deprives the recipient "clients" of the human perspective and tactile engagement, as well as emotional communication with the recreated model in comparison with the original.
Quality	Producing works that appear realistic rather than artificial, simulating original models.		
Abundance	Eliminating limitations on copies and making them available to those who seek them.		

Source: Personal compilation.

6- Algeria and the Digitization of Cultural Heritage (Digital Preservation):

Algeria is among the countries that aspire to protect and preserve their cultural heritage through efforts undertaken in this context and through adherence to international treaties and agreements that stipulate the protection of cultural heritage, its modernization, and keeping pace with digital developments for its safeguarding and preservation.

The Minister of Culture and Arts, "Zouhir Ballalou," affirmed that the Algerian state, under the leadership of the President of the Republic, Mr. Abdelmadjid Tebboune, attaches great importance to the protection of cultural heritage as stipulated in Article 76 of the Constitution. He explained that the cultural sector has effectively engaged in the national AI strategy, noting that the sector has incorporated 12 key projects within the national digitization plan, including support for scientific research, encouragement of start-ups, and the involvement of universities and civil society.

The Minister also addressed the completion of the Algerian archaeological map at the level of the National Center for Archaeology, and the launch of an interactive

geographic information system that supports cultural decision-making and establishes a national digital reference. He revealed a new economic approach adopted by the ministry based on valorizing heritage as a strategic resource for national development through supporting youth, assisting start-ups, and providing an enabling environment for their initiatives within museums and archaeological sites. In this regard, the Minister announced the launch of the first national challenge for students in the field of AI directed toward the protection of cultural heritage, supervised by the higher education sector through its incubator platform (Ifrah, 2025)

Among the measures undertaken by Algeria to keep pace with the digitization of cultural heritage are the following**:**

6.1- Creating Websites and Electronic Portals:

In 2016, the Ministry of Culture announced the official launch of a new multimedia portal dedicated to Algerian cultural heritage, titled "The Algerian Cultural Heritage Portal." The portal includes numerous sections and spaces covering music, literature, manuscripts, folk tales, theatre, and other domains. Recently, two websites dedicated to Algerian manuscripts were also launched within the framework of the "Euro-Mediterranean Heritage" program, which focuses on shared cultural heritage among Mediterranean countries. The first site contains no fewer than 300 digitized documents, the oldest of which dates back to the thirteenth century, while the second site is devoted to iconographic documents "images, engravings, and drawings" considered part of Algerian heritage.

6.2- Digitization of Manuscripts:

The roots of digitization at the National Library of Algeria date back to 1989, when the library began digitizing manuscripts, rare books, and documents. Approximately 2,000 manuscripts were digitized. In 2009, an initiative titled "2009: The Year of Digitization" was launched, during which 2,251 manuscripts were digitized. In 2011, within the framework of cooperation between Emir Abdelkader University and the United States Embassy, 148 manuscripts were digitized. The National Center for Manuscripts in Adrar also carried out archiving and digitization operations for 153 manuscripts **(Shalabi, Chahrazed (2024), p.121).**

6.3- Digitization of Theatre:

The Algerian theatre sector digitized 921 theatrical works, including videos and theatrical texts (**Belhouchat, Zoubir & Rahaili, Mouhamed (2024), p.10)**.

6.4- Digitization of Cinema:

In 2016, the Algerian Cinematheque, affiliated with the Ministry of Culture, digitized 15 short films from rare cinematic works produced in the 1960s. In addition, 1,000-reel tapes corresponding to more than 5,000 film titles were

digitized. The Center for Cinema and Audiovisual also digitized 16 feature-length films considered classics of Algerian cinema (Belhouchat, Zoubir & Rahaili, Mouhamed (2024), page 10).

Algeria continues to intensify its efforts to establish and keep pace with the Fourth Industrial Revolution embodied in AI. The Higher School of AI was established in 2021, and the specialization has been extended to more than 100 universities. The Algerian state also continued in 2024 and 2025 to expand training by introducing AI and digitization modules into most university disciplines, including the humanities and languages, with the aim of gradually generalizing digital culture among students. Despite these attempts undertaken by the Algerian state to protect and preserve cultural heritage digitally, procedural steps remain modest and require greater efforts at all levels, given that AI has become essential for safeguarding and sustaining cultural heritage rather than merely a luxury.

VI. Challenges of Digitally Preserving Cultural Heritage:

Despite the many advantages and positive aspects brought by the Fourth Industrial Revolution, it also has implications that may be summarized as follows:

- Security and privacy risks: digital heritage may be exposed to breaches, theft, or damage.
- Distortion: biased or inaccurate algorithms may be introduced, resulting in the production of versions that are distorted from the original.
- Digital forgery: heritage may be subject to digital theft and looting, and models unrelated to the country promoting them may be replicated.
- One of the most prominent challenges facing the integration of AI in the heritage sector is the lack of training and the absence of the necessary resources to acquire modern technologies.
- Weak infrastructure.

- Conclusion:

In summary, heritage constitutes the identity and memory of peoples, and it is therefore imperative to protect it by all possible means and methods. The integration of AI applications represents one of the advanced and effective mechanisms mobilized for safeguarding cultural heritage, capable of opening new horizons toward sustainable digital heritage. Nevertheless, the challenge remains in seeking the most effective ways to reduce the risks and implications of AI for cultural heritage.

- **Study Recommendations:**

1. A comprehensive strategy should be adopted across political, economic, and social dimensions to ensure the safeguarding of cultural heritage and guarantee its sustainability.
2. Scientific research should be encouraged to develop algorithms capable of preserving the sustainability of cultural heritage.
3. Efforts must be made to promote cooperation between specialists in AI and professionals in heritage and archaeological sciences.
4. Human resources should undergo training in digitization and AI technologies.
5. Arab, regional, and global cooperation should be strengthened to promote digitization and AI technologies and to reduce disparities between countries.

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