Cultural preservation and digital heritage: challenges and opportunities

Preservação cultural e património digital: desafios e oportunidades

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Abstract

This research aims to examine the challenges and opportunities associated with the digitization of cultural heritage. It seeks to provide insights into the dynamic interplay between technological advancements and the preservation, documentation, and promotion of cultural landmarks. The study employs a comprehensive literature review, analyzing recent scholarly works and case studies to understand the evolving landscape of digital heritage preservation. The results highlights the multifaceted challenges encountered in the digitization process, including issues related to digital obsolescence, accessibility, copyright, data security, and resource constraints. Simultaneously, it identifies opportunities where digital tools contribute significantly to the documentation, archiving, and accessibility of cultural artifacts, traditions, and languages. The

Resumo

Esta investigação visa examinar os desafios e as oportunidades associados à digitalização do património cultural. Procura fornecer informações sobre a interação dinâmica entre os avanços tecnológicos e a preservação, documentação e promoção marcos culturais. O estudo recorre a uma revisão exaustiva literatura, analisando trabalhos académicos recentes e estudos de casos para compreender o panorama evolução da preservação do património digital. Os resultados destacam os desafios multifacetados encontrados no processo de digitalização, incluindo questões relacionadas a obsolescência digital, a acessibilidade, os direitos de autor, a segurança dados e as limitações de recursos. Simultaneamente, identifica oportunidades as ferramentas digitais contribuem significativamente para a documentação, o arquivo acessibilidade de artefactos culturais, tradições e línguas. Os

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results suggest that, especially in the context of Russian-Ukrainian war, digital initiatives play a pivotal role in mitigating risks and ensuring the continued existence and appreciation of diverse cultural legacies. The findings underscore the intricate relationship between geopolitical events and the role of digital strategies in safeguarding and showcasing cultural heritage globally. To sum up the fusion of technology and cultural preservation efforts not only addresses immediate threats, but also provides a forward-looking approach to ensuring the resilience and accessibility of cultural treasures in an evolving world.

Keywords: Digital transformation, documentation, cultural artifacts, accessibility, heritage preservation.

resultados sugerem que, especialmente no contexto da guerra russo-ucraniana, as iniciativas digitais desempenham um papel fundamental na atenuação dos riscos e na garantia da existência e apreciação contínuas de diversos legados culturais. Concluise que a fusão da tecnologia com os esforços de preservação cultural não só resposta às ameaças imediatas, como também estabelece uma abordagem orientada para o futuro, a fim de garantir a resiliência e a acessibilidade dos tesouros culturais num mundo em evolução.

Palavras-chave: Transformação digital, documentação, artefactos culturais, acessibilidade, preservação do património.

Introduction

Research problem

In an era defined by rapid technological advancements and an increasingly interconnected global society, the preservation of cultural heritage has become a paramount concern. The intersection of culture and technology has given rise to a fascinating and complex landscape known as digital heritage. As societies around the world grapple with the challenges of preserving their rich cultural legacies, the integration of digital tools and technologies presents both unprecedented opportunities and unique obstacles.

The concept of establishing a comprehensive paradigm that unifies progress in innovation is currently taking shape within the contemporary scientific discourse (Sofilkanych, 2022). According to Maraieva (2022) this paradigm envisions technologies serving as tools, with information playing a synergistic role that connects humans, society, nature, and technology. In this envisioned framework, technological advancements are not merely isolated developments but integral components, harmoniously interacting with information to create a symbiotic relationship among individuals, communities, the environment, and the tools themselves (Maraieva, 2022). Therefore, the integration of technology and information within this overarching paradigm seeks to foster a holistic approach to progress, emphasizing the interconnectedness and interdependence of various elements in current evolving societal and scientific landscape. The realization of an encompassing paradigm aimed at consolidating progress in innovation is actively unfolding within the contemporary scientific dialogue, as discussed by Trček (2022). This paradigm envisions technologies not merely as standalone advancements but rather as integral tools (Yatsenko, 2022). Within this conceptual framework, information assumes a synergistic role, fostering meaningful connections among humans, society, nature, and technology (Durmishi & Durmishi, 2022).

Research focus

The advent of the digital age has introduced innovative methods to document, archive, and share these cultural treasures. From digitizing ancient manuscripts and artefacts to creating virtual museums and online archives, the digital realm opens up new avenues for the conservation and dissemination of cultural heritage.

However, with these opportunities come challenges that demand careful consideration. The digital landscape introduces concerns related to data security, accessibility, and the risk of cultural commoditisation. Additionally, as communities strive to strike a balance between traditional preservation methods and cutting-edge technologies, questions emerge about the authenticity and integrity of digitally preserved cultural artefact.

Reseaerch aim and research questions

The aim of this study is to explore the challenges and opportunities inherent in the intersection of cultural preservation and digital heritage, with a

focus on understanding how digital technologies impact the safeguarding and dissemination of cultural legacies. The circle of research questions consists of the following aspects:

1. To investigate how digital technologies facilitate the conservation of cultural heritage, delineating specific tasks that contribute to the effective transmission of oral traditions, rituals, and folklore to future generations.
2. To explore how digital tools and technologies contribute to the documentation, archiving, and accessibility of cultural artefacts, traditions, and languages, outlining specific tasks and methodologies employed.
3. To investigate the primary challenges encountered in digitally preserving cultural heritage, examining issues related to authenticity, integrity, and the potential commodification of cultural artefacts.

Therefore, given the relevance of digitalization, this study aims to clarify the challenges and opportunities of cultural preservation and heritage. The main challenges that require detailed analysis include copyright and intellectual property issues, data security and privacy concerns, standards and interoperability, and ethical considerations.

Theoretical framework or literature review

International experiences provide valuable insights into the normative clarification of the cultural heritage concept, particularly within the realm of global intellectual discourse. This elucidation is closely intertwined with the conceptual generalizations found within scientific disciplines of the humanitarian profile (Marsili & Orlandi, 2020; Synowiec, 2021). The growing interest among researchers in the intricate nuances of cultural heritage has not only stimulated a significant expansion of cognitive and axiological dimensions but has also heightened the urgency for constructive responses to fundamental questions. These crucial inquiries delve into the identification of elements that should be preserved and the methodologies for selecting cultural values deserving of protection. Diverse approaches to understanding the essence of cultural heritage contribute to the construction of a nuanced and multifaceted image of this concept (Shevchenko, 2020). The genetic approach posits cultural heritage as a paramount influence on national self-awareness, self-identification, historical memory, and the evolution of human culture

throughout history. From a geographical standpoint, cultural heritage emerges as a formidable resource for preserving both natural and cultural diversity within the broader ecological context (Kubiv et al., 2020; Bobro, 2023). This form of heritage is foundational for fostering the balanced development of both society and the biosphere. Within the semiotic perspective, cultural heritage is broadly perceived as a collection of texts inherited by mankind. These encompass not only written works but also artistic creations, collectively serving as a repository of cultural memory (Synowiec, 2021). In parallel, the term "digital heritage" introduces a dual connotation. It can refer to cultural heritage presented in digital form or signify the digitized (electronically formatted) cultural heritage. Contemporary researchers have been intrigued by the issue of preserving cultural heritage through the use of digital technologies. Current studies encompass various aspects of cultural heritage preservation and accessibility, leveraging digital technologies. Antoniazzi (2020) addressed the challenges of digital preservation and sustainability in film heritage, emphasizing the analysis of digital technology utilization for the longevity of cinematic heritage. However, this paper serves only as a theoretical framework, as the author did not provide detailed examples of local challenges. Basic (2019) explored key aspects of utilizing advanced technologies in the realm of cultural heritage. However, this study also has certain limitations, in particular, the author approached this problem globally without focusing on specific examples. In the work of DA Costa & Santos (2023), UNESCO's strategy for memory preservation in Ukraine through the Polycam mobile application was presented, analyzing the impact of digital technologies on recording and preserving cultural heritage in conflict zones. Dässler & Preuss (2019) described issues related to digital preservation of cultural heritage, focusing on small institutions, and characterized methods and strategies for ensuring accessibility and preservation of digital archives in smaller settings. Simultaneously, Ferrer-Yulfo (2022) focused on analyzing the use of digital technologies for transforming museum education through intangible cultural heritage. In a comprehensive study, Fisher (2020) identified key challenges and strategies for preserving materials created in digital formats, with a specific emphasis on copyright issues. Flierl & Haspel (2022) described crucial contemporary challenges and opportunities in the preservation of world heritage, characterizing the impact of digital technologies on the understanding, documentation, and preservation of objects

within the global heritage context. The analyzed works collectively underline the vital role of digital technologies in preserving and making accessible various forms of cultural heritage. Researchers delve into challenges, strategies, and the transformative impact of digital tools, emphasizing the significance of technological advancements in safeguarding our diverse cultural legacy (McHugh, 2023). However, the main limitations of these studies are their general nature. Nevertheless, it is important to comprehensively approach the problem and characterize the main possibilities of digital technologies in the system of preservation of cultural heritage and memory. Thus, the modern literature raises the issue of mechanisms and forms of digitalization of cultural heritage in detail, but not all possibilities are covered in such

detail. Also, contemporary scholars have not paid much attention to analyzing the main difficulties of implementing digitalization in the field of cultural heritage, which is the purpose of this paper.

Methodology

The study focuses on the intersection of cultural preservation and digital heritage, examining the challenges and opportunities arising in the context of digitizing cultural heritage. The phenomenon involves the digitization of various cultural elements, including artifacts, traditions, and linguistic resources, to explore the multifaceted implications for preserving and disseminating cultural legacies (See Figure 1).
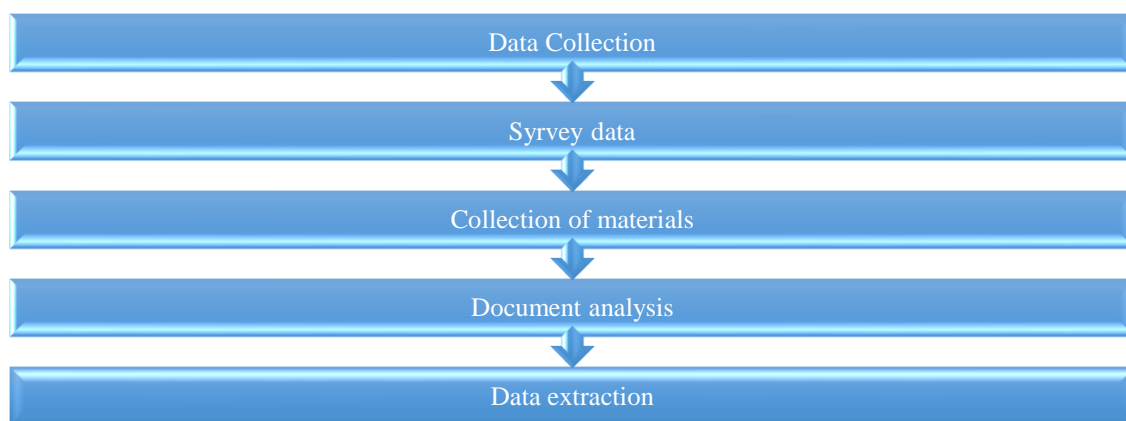
Figure 1. Research design
Source: Author's development

Data collection and data analysis

1. Survey data

Authors used the survey conducted by Adane, Chekole & Gedamu (2019).

Participants: the survey targeted professionals engaged in cultural preservation within archive and tourism offices, as well as university libraries. The participants were selected based on their direct involvement in digitization processes and their perspectives on the challenges and opportunities in preserving cultural heritage through digital means.

Data collection method

A structured survey questionnaire was distributed, covering aspects such as current digitization practices, perceived challenges, successful strategies, and future aspirations.

Open-ended questions allowed participants to provide qualitative insights, while closed-ended questions provided quantitative data for analysis.

2. Document analysis

Materials examined:

o   The Comprehensive Report of the European Commission: Report on Cultural Heritage: Digitisation, Online Accessibility and Digital Preservation (European Commission, 2019).
o   Association Agreement between Ukraine and the European Union, emphasizing cultural collaboration and cooperation (Muraviov, 2015).
o   2013 Decree of the Cabinet of Ministers on the Strategy for the Development of the Information Society in Ukraine (Law of Uktaine No. 386-p., 2013).

o 2016 Decree on the Long-term Strategy for the Development of Ukrainian Culture – Reform Strategy (Law of Uktaine No. 119, p., 2016).
o Library Development Strategy until 2025, approved in 2016. (Goverment of Lithuania, 2016)
o The Slovenian Public Libraries Development Strategy 2022-2027 (Goverment of Slovenia, 2022).
o The library development concept in the Czech Republic between the years 2021-2027, with prospect to 2030 (Goverment of Czech Republic, 2021).

Data extraction: relevant information pertaining to digital cultural heritage preservation, legislative priorities, and strategic frameworks was systematically extracted from the documents.

Thematic coding: a thematic coding approach was employed to categorize and analyze the extracted data, identifying key themes such as legal frameworks, cultural collaboration, and strategies for digital preservation. Therefore, on the basis of synthesis and comparison analysis, process and compare data from the survey and data from legislative acts. This involved systematically identifying key themes within the data, such as legal frameworks, cultural collaboration, and strategies for digital preservation. For instance, each piece of data was carefully examined and assigned to relevant themes based on its content and context. For instance, data pertaining to legal frameworks included references to international conventions,

national legislation, or judicial decisions related to the topic of interest. Similarly, instances of cultural collaboration identified through references to partnerships between cultural institutions, collaborative projects, or joint initiatives aimed at cultural preservation. Furthermore, the process of synthesis and comparison analysis involved systematically comparing data collected from surveys with information extracted from legislative acts.

One of the main limitations of thematic coding is its susceptibility to researcher bias. While the thematic coding approach used in this study provides valuable insights into the data, it is important to acknowledge its limitations in order to ensure that the interpretation of the findings is nuanced and comprehensive. Despite efforts to establish clear coding criteria, the interpretation of data and the allocation of codes can still be influenced by the subjective perspective of the researcher. Such subjectivity can lead to inconsistent or imprecise coding, which can affect the reliability and validity of the findings.

Results and discussion

The dynamic interplay between traditional and digital aspects adds a layer of complexity to the evolving landscape of cultural heritage conservation. Therefore, digital technologies play a pivotal role in facilitating the conservation of cultural heritage by offering innovative tools and approaches that enhance documentation, preservation, and dissemination efforts. Figure 1 presents the main aspects of preserving cultural heritage with the help of digital technologies.
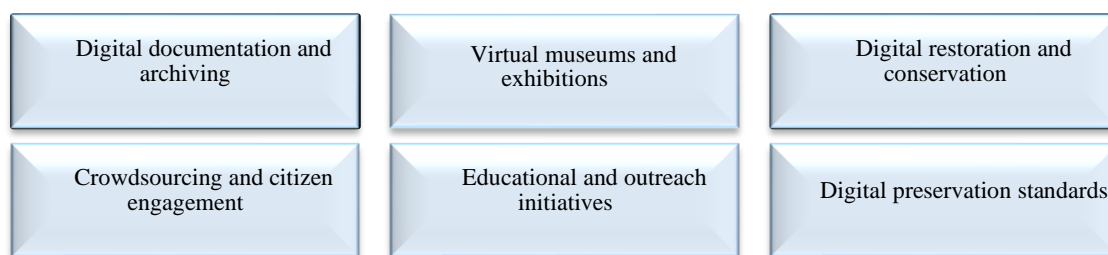
Figure 1. Several aspects of preserving cultural heritage with the help of digital technologies.
Source: author's development

Hence, digital technologies enable the creation of comprehensive databases and archives for cultural artifacts, historical documents, and other heritage items. High-resolution cameras, 3D scanners, and advanced imaging techniques allow for detailed and accurate documentation. Authors believe that digital archiving ensures the preservation of fragile or deteriorating materials by creating electronic replicas, reducing the need

for physical handling (Pandey & Kumar, 2020). As demonstrated in Figure 1 digital platforms provide opportunities to develop virtual museums and online exhibitions, allowing global audiences to access cultural artifacts and exhibits remotely. Moreover, digital tools aid in the restoration and conservation of artworks, artifacts, and historical sites (Anderson, 2013; Kuzheliev et al., 2023). Digital restoration

techniques can repair damaged elements without altering the original physical object. Conservationists use 3D printing and digital modeling to recreate missing or damaged parts of cultural items, ensuring their integrity over time. On the other hand, digital platforms facilitate crowdsourcing initiatives, encouraging public participation in the identification, documentation, and preservation of cultural heritage (Von Schorlemer, 2020). Therefore, citizen engagement through social media and online forums helps raise awareness, garner support, and involve communities in the protection of their heritage. As demonstrated in Figure 1 digital preservation standards also have important role. Standardized digital preservation practices, including metadata standards and digital storage protocols, ensure the long-term accessibility and sustainability of digital collections related to cultural heritage. In addition, digital technologies provide avenues for educational programs and outreach initiatives, offering virtual classrooms, online courses, and interactive learning materials that promote cultural heritage awareness and appreciation (Dässler & Preuss, 2019). Hence, digital tools and technologies play a crucial role in the documentation, archiving, and accessibility of cultural artifacts, traditions, and languages. By leveraging these digital tools, cultural heritage professionals, communities, and organizations can enhance their conservation efforts, ensuring the preservation and transmission of cultural richness to future generations. Table 1 describes how digital tools are used for cultural heritage preservation purpose.

Table 1.
Ways of using digital tools for cultural heritage preservation

Digital documentation of cultural artifacts	
High-resolution imaging	Advanced cameras and imaging technologies capture high-resolution images of cultural artifacts, ensuring detailed documentation.
3D scanning	For three-dimensional objects, 3D scanning creates digital replicas, preserving intricate details and allowing for virtual exploration.
Digital archiving of cultural materials	
Digital repositories	Cultural artefacts, historical documents, and multimedia materials are stored in digital repositories, creating centralized databases for efficient archiving.
Metadata tagging	Each artefact is accompanied by metadata, providing crucial contextual information, such as origin, significance, and historical context.
Preservation of traditional practices and performances	
Audio-visual recording	Traditional music, dance, rituals, and performances are recorded using audio and video technologies to ensure accurate preservation.
Virtual reality and augmented reality	These technologies offer immersive experiences.
Digital documentation of languages	
Language digitization	Digital tools are employed to transcribe, record, and digitize endangered languages, ensuring their preservation.
Machine translation and natural language processing	
Translation tools	Machine translation tools contribute to the translation of cultural texts, enabling broader accessibility.
Natural language processing	Technologies analyze and interpret linguistic nuances, aiding in the documentation and analysis of languages.
Community engagement and crowdsourcing	
Digital platforms	Online platforms and social media encourage community participation in documentation efforts, allowing individuals to contribute their knowledge, stories and artefacts.
Crowdsourced translation	Communities contribute to the translation of texts, ensuring accuracy and cultural sensitivity.
Geospatial technologies for cultural heritage sites	
Geographic information systems (GIS) mapping	GIS map cultural heritage sites, aiding in their documentation, conservation planning, and monitoring
Location-based apps	Mobile apps with geolocation features provide virtual tours and information about cultural heritage sites.
Accessibility through online exhibitions and virtual museums	
Virtual exhibitions	Digital tools enable the creation of virtual exhibitions, making cultural artifacts and traditions accessible to a global audience.
Online collections	Institutions create digital collections, allowing users to explore and learn about cultural heritage items from anywhere in the world.

Source: Author's development.

In a comprehensive survey conducted by Adane, Chekole & Gedamu (2019) within the spheres of archive and tourism offices, as well as university libraries, participants were actively engaged in providing valuable insights into the multifaceted opportunities associated with the digitization of cultural heritage. Respondents were particularly vocal about the positive impact of digitization on cultural heritage promotion. A substantial majority, totaling 96% conveyed a unanimous and favorable perspective, highlighting the potential for digital platforms to effectively promote and showcase cultural heritage. The survey also delved into the crucial aspect of digitization in cultural heritage preservation. The findings revealed that 54% of respondents expressed a resounding "strongly Agree" sentiment, emphasizing the pivotal role of digitization in safeguarding cultural heritage. Additionally, 42% of participants acknowledged with the importance of digitization in preserving rich cultural legacy (Adane, Chekole & Gedamu, 2019).

One noteworthy revelation from the survey pertained to job opportunities for the youth generated through cultural heritage digitization. A significant 32% "strongly Agreed", indicating a strong consensus on the positive impact of digitization in creating employment opportunities for the younger generation (Adane, Chekole & Gedamu, 2019). The survey participants also weighed in on the role of cultural heritage digitization in enhancing research works. 48% agreed that digitization significantly contributes to research endeavors, while an additional 36% agreed, reflecting the widespread acknowledgment of the positive correlation between digitization and scholarly pursuits within the cultural heritage domain. Furthermore, the survey brought to light the impact of cultural heritage digitization on online visits and online selling. A majority of 44% of participants recognized the role of digitization in promoting online engagement (Adane, Chekole & Gedamu, 2019). This aspect underscores the evolving landscape of cultural heritage experiences, emphasizing the potential of digital initiatives to enhance accessibility and audience engagement. In summary, the survey results not only reaffirm the positive perceptions surrounding the opportunities presented by cultural heritage digitization but also shed light on the varied ways in which digitization contributes to cultural heritage promotion, preservation, employment generation, research advancement, and online engagement.

At the same time, the contemporary milieu marked by the ubiquity of digital technologies, the preservation of cultural heritage encounters a confluence of challenges and opportunities at the intersection of tradition and technological evolution. The paradigm shift towards digital heritage entails not merely the digitization of tangible artifacts but also engenders intricate complications pertaining to their enduring conservation, equitable accessibility, and ethically sound representation in the digital domain (Hurska & Parshyn, 2023; Prykhodko, 2019). This discourse delves into the nuanced challenges inherent in the amalgamation of cultural preservation and digital heritage, dissecting intricacies such as digital obsolescence, inclusivity metrics, copyright complexities, and the ethical underpinnings of digital representations. By scrutinizing these challenges through a scientific lens, it is better to seek to elucidate the imperative for an interdisciplinary and pioneering approach to ensure the perpetuity of diverse cultural legacies in the digital epoch. Preserving cultural heritage in the digital age presents numerous challenges, as the intersection of traditional cultural preservation and the rapidly evolving digital landscape introduces both opportunities and risks. Scientists remarked some key challenges associated with cultural preservation and digital heritage (See Table 2).

Table 2.
Important challenges of cultural preservation in the digital heritage

Challenge	Characteristic
Copyright and intellectual property issues	Digital reproduction and dissemination of cultural artifacts often involve complex copyright and intellectual property considerations. Striking a balance between protecting creators' rights and facilitating broader access to cultural heritage materials is a continual challenge.
Data security and privacy concerns	The digitization of cultural artifacts raises concerns about the security and privacy of sensitive information. Safeguarding digital heritage from unauthorized access, data breaches, and cyber threats is paramount to maintaining trust and integrity.
Resource constraints	Preserving digital heritage requires significant financial and human resources. Many cultural institutions, especially smaller ones, may struggle to allocate sufficient funds and expertise for digital preservation initiatives.
Standards and interoperability	Lack of standardized practices for digitization and metadata creation can hinder interoperability between different cultural heritage databases. Establishing common standards is essential for seamless sharing and integration of digital heritage materials.
Digital conservation and restoration challenges	Unlike physical artifacts, digital materials may require ongoing conservation efforts due to format degradation, software dependencies, and other technical issues. Digital restoration practices need to be developed and refined to ensure the longevity of digital cultural heritage.
Ethical considerations	Digitization raises ethical questions, such as the appropriate use of cultural artifacts and the potential for misrepresentation or misuse. Establishing ethical guidelines and involving communities in decision-making processes is crucial to address these concerns.
Cultural sensitivity and representation	Digitization efforts must be conducted with cultural sensitivity to avoid misappropriation or distortion of cultural narratives. Ensuring accurate representation and involvement of communities in the digitization process is vital.
Global collaboration and coordination	Cultural heritage is often shared across borders, and effective preservation requires international collaboration. Coordinating efforts, sharing best practices, and addressing challenges on a global scale are essential for the comprehensive preservation of digital heritage.

Source: Author's investigation on the basis of Synowiec (2021); Skakun (2022).

Digitization of cultural monuments has become an important issue for European countries. In particular, separate models of its implementation are introduced centrally - at the international and national levels. The "Comprehensive Report" of European Union covering the period 2015-2017 reveals that a significant proportion of Member States of EU have formulated their respective National Digitization Strategies. Specifically, 19 out of 28 Member States (at that time, considering the UK as part of the EU) have established these strategies, with the majority operating under the central coordination of the pertinent ministry or ministries (European Commission, 2019). Additionally, 17 out of 28 Member States have instituted national funding programs to support digitization initiatives. It is noteworthy that certain countries integrate their national strategies for the digitization of cultural heritage within broader national digital programs (Goverment of Slovenia, 2022). For instance, in Lithuania, digitalization constitutes a component of the Digital Agenda for the Republic of Lithuania. The primary domains of focus for

advancing the virtual space for cultural heritage are delineated in the Program of Digital Cultural Heritage Actualization and Preservation for the period 2015-2020 (Goverment of Lithuania, 2016).

The experience of Ukraine is also very important for understanding of cultural preservation and digital heritage challenges. Ukraine currently lacks a comprehensive digitalization strategy, although the legislative groundwork for its formulation is evident. The surge in European integration initiatives, particularly following the signing of the "Association Agreement between Ukraine and the European Union" in 2014, emphasizes cultural collaboration in Chapter 24 (Muraviov, 2015). This chapter outlines a commitment to enhance cooperation in the cultural sphere, promoting mutual understanding, cultural exchanges, and the mobility of artistic entities between Ukraine and the EU. Remarkably, an examination of the analytical reports on the EU-Ukraine Agreement Implementation for 2019 reveals a notable

absence of information concerning cultural cooperation, specifically in the digitization of cultural heritage (Prykhodko, 2019). It becomes apparent that, within the spectrum of Ukraine-EU integration issues, cultural integration receives insufficient attention. Despite this, Ukraine has laid the foundation for a potential national digitization strategy through various legislative documents. Noteworthy among these are the 2013 Decree of the Cabinet of Ministers, which approves the "Strategy for the Development of the Information Society in Ukraine," emphasizing E-culture development (Law of Uktaine No. 386-p., 2013). Additionally, the 2016 Decree on the "Long-term Strategy for the Development of Ukrainian Culture – Reform Strategy" prioritizes the preservation of cultural and spiritual heritage (Law of Uktaine No. 119, p., 2016). The Library Development Strategy until 2025, approved in 2016, further underscores the commitment to preserving Ukrainian cultural heritage within library resources, treating them as integral components of the global cultural heritage (Prykhodko, 2019). These legislative measures provide a basis for Ukraine to advance its digitalization endeavors in the cultural sphere.

The Russian invasion of Ukraine in 2022 significantly altered the approach towards digitizing cultural heritage in the country. This war heightened all aspects of national security, including the preservation and protection of cultural heritage. Firstly, the Russian aggression necessitated the implementation of effective measures to preserve cultural artifacts, as conflict-ridden areas faced the risk of destructive impact. This underscored the need to utilize digital technologies for creating virtual copies of valuable objects and documenting their condition for future restoration. Secondly, due to the risk of losing parts of the cultural heritage through conflict and occupation, Ukraine expressed increased interest in detailed documentation and preservation of these treasures. This requires the use of modern technologies for digital cataloging and archiving of cultural landmarks. Thirdly, the role of digital technologies proved crucial in studying and popularizing Ukrainian culture as a means of resistance to identity suppression and historical aggression. Digital media and online platforms enable a wide audience to explore and appreciate Ukraine's rich cultural heritage, serving as an important tool for informing and highlighting the context of the conflict. Thus, the Russian invasion prompted not only changes in the security of cultural heritage but also an intensified use of digital technologies for the preservation, documentation, and promotion of Ukraine's cultural landmarks.

The obtained results underscore the importance and effectiveness of utilizing digital tools and technologies in documenting, archiving, and providing access to cultural artifacts, traditions, and languages. Specifically, the results affirm the efficiency of documentation, highlighting that high-quality images and 3D scanning enable detailed and accurate documentation of cultural artifacts. Simultaneously, the use of digital repositories and metadata contributes to the systematic and efficient archiving of materials. Furthermore, the results emphasize that audio and video recordings facilitate the preservation of traditional musical, dance, and ritual performances. The incorporation of virtual reality and augmented reality ensures an immersive experience in participating in traditional events. These findings align with contemporary scholarly works (Pandey, & Kumar, 2020; Shiri et al., 2021). For instance, Karle & Carman (2020) elucidate how a digital heritage project can impact the research and interpretation of large-scale rural cultural landscapes, emphasizing the critical importance of wide-scale documentation methods for advancing preservation initiatives.

However, the obtained results somewhat contradict the assertions of Mohd Herrow & Azraai (2021), who emphasize the interconnectedness of culture and heritage. There are points of divergence or areas for further discussion, particularly regarding the broad characterization of culture, focusing solely on ethical actions, values, creativity, knowledge, traditions, and beliefs. Additionally, the study challenges the notion presented by Mohd Herrow & Azraai (2021) that cultural heritage is a legacy not only of each nation but also of humanity as a whole, asserting that certain elements may be culturally specific rather than universal.

In the results, it is evident that the Russian invasion of Ukraine in 2022 has left a profound mark on the strategies and priorities associated with digitizing cultural heritage in the country. The war's far-reaching implications have reverberated across various aspects of national security, with a heightened emphasis on the critical need for the preservation and protection of Ukraine's rich cultural legacy. As a response to the increased risk of destructive impact on conflict-affected areas, the adoption of digital technologies has become a pressing necessity. This involves the creation of virtual copies of valuable cultural artifacts and meticulous documentation of their condition, laying the foundation for future restoration efforts. Additionally, the heightened risk of losing parts

of the cultural heritage through conflict and occupation has spurred a surge in interest in detailed documentation and preservation measures. To meet these challenges, modern technologies play a pivotal role in the digital cataloging and archiving of cultural landmarks, ensuring their safeguarding for future generations. The results also confirm the existence of numerous challenges in the path of digitizing cultural heritage, such as digital obsolescence, accessibility and inclusivity, copyright and intellectual property issues, data security and privacy concerns, resource constraints, digital conservation and restoration challenges, and ethical considerations.

Meanwhile, Adane, Chekole, Gedamu's (2019) work lists other challenges, particularly emphasizing cultural heritage accessibility and promotion and preservation. However, the study does not explore external factors contributing to these challenges, such as broader economic conditions, technological infrastructure, or governmental support.

Furthermore, the study challenges some perspectives presented by Von Schorlemer (2020), questioning the subjective nature of the concept of a "fair balance" between the rights of creators and the public's right to access digital heritage materials, especially in the context of digital heritage.

In summary, the scientific novelty of the work lies in its contribution to understanding how digital technologies integrate to ensure the preservation of cultural heritage. The analysis of contemporary challenges arising from digital transformation indicates a scholarly interest in developing solutions for the long-term preservation of cultural heritage.

Conclusions

Hence, the research highlights the significance of digital tools and technologies in documenting, archiving, and enhancing accessibility to cultural artifacts, traditions, and languages. The findings underscore the effectiveness of digital methods such as high-quality imaging, 3D scanning, virtual reality, and augmented reality in ensuring the detailed documentation and immersive experience of cultural heritage. Authors emphasize the importance of addressing challenges such as digital obsolescence, accessibility and inclusivity, copyright issues, data security, and ethical considerations in the process of digitizing cultural heritage.

Furthermore, the Russian invasion of Ukraine in 2022 significantly impacted the approach towards digitizing cultural heritage in the country. The conflict heightened concerns for the preservation and protection of cultural artifacts in conflict-ridden areas, necessitating the implementation of effective measures. The use of digital technologies became crucial in creating virtual copies of valuable objects and documenting their condition for future restoration. Importantly, digital technologies played a pivotal role in studying and promoting Ukrainian culture as a means of resistance to identity suppression and historical aggression. Thus, the Russian invasion not only brought about changes in the security of cultural heritage but also intensified the use of digital technologies for the preservation, documentation, and promotion of Ukraine's cultural landmarks. Despite certain limitations, such as a focus on recent literature and an emphasis on Ukrainian and English language sources, the study provides a robust contribution to scholarly discourse by identifying new challenges and opportunities in developing cultural heritage through digital technologies. Therefore, future research should focus on a global study rather than on regional areas of cultural digitalisation.

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