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From Digitization to Artificial Intelligence in Capitalizing on Cultural Heritage

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ABSTRACT

Artificial intelligence has become an increasingly used concept in contemporary society, almost in all fields of activity. This new stage in science of IT development, after the fourth industrial revolution which is considered to be the digitization that seemed to be almost deprecated, is the most important discovery of the century. The numerous artificial intelligence tools developed recently led to an increased facilitation of some activities, a fact that had effects on the performance of some fields of activity. This paper aims to first analyze the transition from digitization to artificial intelligence. Also, it is analyzed the current state of the art in the field of artificial intelligence and the possibilities of using the artificial intelligence in preserving the cultural heritage, as well as of the effects that can be generated in this field.

1. Introduction

Artificial intelligence represents one of the greatest discoveries of the current century, with a major impact on all fields of activity, including the field of culture. Artificial intelligence is the next step after digitization, considered to be the fifth industrial revolution today. Its development at an accelerated pace has generated a series of controversies. We may look at the fact that some sort of activities that were made by humans have been replaced quickly by using the artificial intelligence. We may also refer to the fact that recently concerns have been expressed about possible threats regarding the use of artificial intelligence even for the humanity's integrity.

It is obvious that, since the artificial intelligence is used in all fields of activity, this is applicable in the cultural field too and this may come as a counterpart to the preservation of the cultural heritage as numerous tools have been developed and that have a particularly beneficial impact in this field. A very good example is the possible restoration of the famous Notre Dame Cathedral in Paris, which was significantly affected by fire in 2019. Another extremely interesting case is analyzed by other authors, namely the use of artificial intelligence in the restoration of the ancient city of Petra, in the desert of Jordan. They discuss the climate-generated phenomena that have led to the deterioration of over 80% of the sandstone facades of the areological site and the possibility of using artificial intelligence to combat these effects and make Petra a safer place (Goussos, J., Taylor, G., 2020).

2. Literature review

Regarding the concept of artificial intelligence, it is defined by some authors as "the intelligence demonstrated by machines, as opposed to the natural intelligence displayed by animals, including humans" [the intelligence demonstrated by machines, as opposed to the natural intelligence displayed by animals, including humans]. (Sfetcu N., 2021).

Other authors consider that artificial intelligence represents the fifth industrial revolution, after digitalization, due to the special implications that this process has on all fields of activity (Ene L.A., Dumitru D., 2021).

Given the speed with which it has developed and spread throughout society, the question has arisen as to whether artificial intelligence is a modern-day black swan. (Chirila R., 2018).

On the occasion of the first world Summit on using the artificial intelligence, issues related to cyber security from the perspective of the development of artificial intelligence were discussed, reaching the

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conclusion that it is good to have cooperation on the security of new artificial intelligence tools before they are released for use by the general public.

One of the achievements of this Summit was the creation of an AI Safety Institute in the UK which will collaborate with other similar institutions in the US and Singapore (https://www.gov.uk/government/news/prime-minister-launches-new-ai-safety-institute).

Today, we are experiencing another important phase of our world's evolution: the fifth industrial revolution. This revolution is represented by the fast expansion of artificial intelligence. Of course, the transition from digitization to AI was not an easy process. That supposed a certain development of IT solutions that to be used and to be tested in various fields of activity. The main instrument that was used to the development of the artificial intelligence was the digitization. First of all, it was used for converting data from analog to digital and after that creating artificial intelligence was the development of computer systems and software tools capable of handling digitized data, even large volumes of data. The development of AI tools is shown in Figure 1 below:

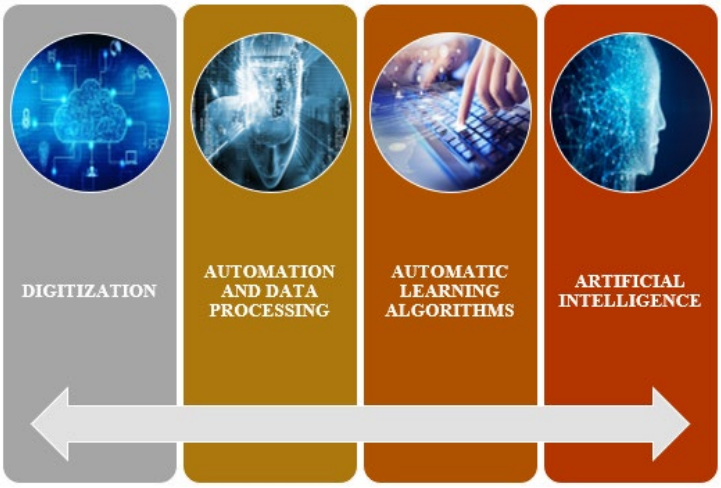


Figure 1. From digitization to artificial intelligence

Source: Authors' own research

The development of artificial intelligence was based on the digitalization process. This process was developed when data from analog format was converted into digital format. The next step in creating artificial intelligence was the development of computer systems and software tools capable of handling digitized data, even large volumes of data. Based on these systems and tools, the next step was the development of machine learning algorithms capable of performing specific tasks requested by humans.

The last phase was the development of deep learning processes, i.e. the use of complex artificial neural networks (https://developer.ibm.com/articles/cc-machine-learning-deep-learning-architectures/). Also, regarding the using of artificial intelligence in culture and heritage preservation, this has generated significant advantages, from the perspective of their preservation, access and perception by the general public, some of which are presented in Figure 2 below:

Figure 2. The best advantages using AI in the cultural field

Source: Authors' own research

Artificial intelligence in the cultural field may have an important role in analyzing works of art. This may come in considering the possibility of reconditioning them and finding real solutions from the point of view of identifying and eliminating all the damages that they may be suffered in time.

Another important role that the artificial intelligence may have in the cultural field is the possibility of automatic self-indexing some of the components of cultural heritage and quick access of the public to the information, if we refer to the globalization process that has also brought with it the need to translate documents, works of art, maps, etc.., into the main languages of international circulation, a fact which enabled global access to the information.

The parallel development of virtual reality and augmented reality has led to the possibility of generating unique experiences, through the increased degree of interactivity of users with works of art, including the recreation of historical events/places in real time. Artificial intelligence can also present negative effects from the category of those already identified and known in general (cyber security), but also specific risks, related to copyright (European Commission, 2022).

3. Methodology

This work was carried out through qualitative research, respectively through exploratory techniques (Garboan R., 2007), which aims to familiarize with the concept of AI and the implications of this process in terms of its use in the field of culture, respectively in terms of concerns the preservation of cultural heritage. The EU regulations in the field ofg using artificial intelligence and also the regulations that were issued countrywide were analyzed, in order to obtain a better understanding of this concept.

Also, the main benefits but also the possible negative effects that these tools may have in terms of cultural heritage were analyzed. All these information are used in order to see if the artificial intelligence may contribute to a better preservation and ease access to the culture.

4. Analysis/Results interpretation

The information collected in this research concerning the use of AI in cultural heritage at the EU level in this field rise a lot of discussions regarding copyright and the compliance with ethical principles. The development of AI that has reached such a level that it is able to create musical content, videos or even poems, raised a series of questions related to the copyright: who is the owner of these creations and whether the question of copyright can be raised in this case. There are opinions that the copyright owner of the content made by artificial intelligence is the programmer, that is, the one who created the model of artificial intelligence (Palace V.M.., 2019).

The perspective that has been observed at the EU level regarding the use of AI has revealed that there was established a special Parliamentary Commission for artificial intelligence in a digital age within the European Parliament, which is headed by a Romanian MP. This commission consists of 33 members and aims to analyze the impact of artificial intelligence in various fields (https://www.europarl.europa.eu/news/ro/press-room/20200923IPR87711/new-committee-on-artificial-intelligence-begins-its-work).

The concern regarding the development of artificial intelligence at the level of the European Union is also noted by the development of other documents regarding this field, including the attempt to develop a regulatory legal framework that covers all the problems that could arise in this field. In fact, some authors believe that these ethical concerns can also refer to the possibility of an impartial interpretation of a work of art (Pansoni S. et all, 2023). In Romania, regarding the financing of research, development and innovation in the field as a percentage of GDP compared to the EU average, the data are presented in Figure 3 below:

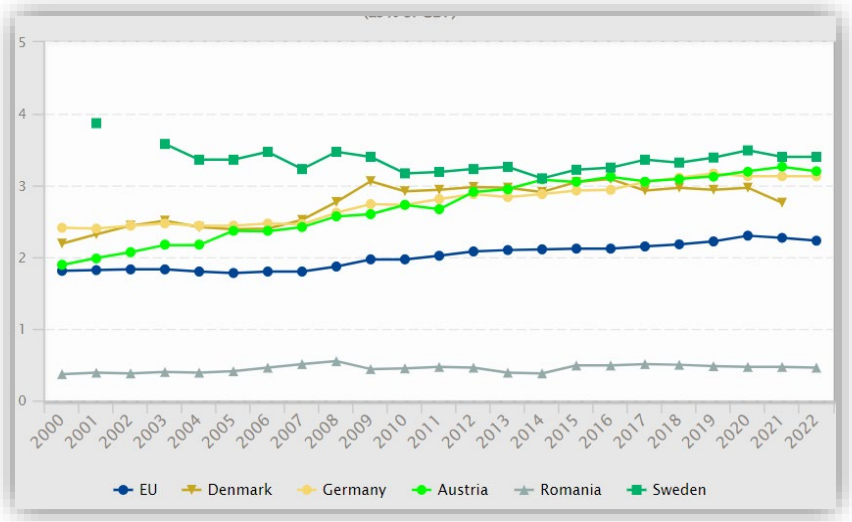


Figure 3. The percentage of GDP allocated by various EU countries to finance research and development compared to the European Union average

Source: (EUROSTAT) (https://ec.europa.eu/eurostat/web/science-technology-innovation/visualisations)

Analyzing the data presented in Figure 3 above, it can be seen that in the case of Romania, the percentage of GDP allocated to research, development and innovation is far below the European average for the entire period between 2000 and 2022. At the opposite pole is a series of countries such as Sweden, Austria, Germany and Denmark, the first place being occupied by Sweden.

The data showed us that the Romanian authorities have shown little interest concerning the funds to be given by national budget to research, innovation and development. Of course, due to that fact, the development of artificial intelligence tools that were supposed to be used in preserving the cultural heritage in Romania was negatively affected, despite that in Romania there is a document that was issued by the Romanian authorities and which is called "National Strategic Framework in the field of artificial intelligence 2023-2027" by the Romanian Authority for Digitization. (Romanian Authority for the Digitization, 2023).

Within this document, at Strategic Objective no. 3.2 Reducing the fragmentation of R&D resources and efforts in AI by conjugating and synchronizing them within national specialized innovation centers and groups, connected to international AI centers and resources there were issued several measures. Among these measures, one is provided regarding the establishment of new academic research centers or in public private partnership in the fields of artificial intelligence. The scope of this measure is to promote cross-disciplinary collaborations, including the development of artificial intelligence tools in the field of culture.

The same document provides for the establishment of a National Artificial Intelligence Supervisory Authority with a role in testing and experimenting with solutions that will be in the field of artificial intelligence, including the development of algorithms aimed at combating disinformation.

At the European level, artificial intelligence was foreseen as a strategic objective within the Digital Europe Program, with a total budget of 2062 million euros, financed by the European Commission. The Digital Europe Program is complementary to other similar programs that are funded by the EU, in particular the Creative Europe program, which gives the cultural sector and creators access to the latest artificial intelligence tools.

AI4Culture is a new concept that was intended at European Union level who has a role in preserving the cultural heritage in the member states and, as a whole, in the European Union. In the matter of the fact, analyzing this concept, we found that this is actually an online hub which is used to develop tools by specialists in order to preserve the cultural heritage with the help of artificial intelligence. This hub is created within the EUROPEAN PRO online library.

The purpose of this hub is to enable those interested to access a collection of AI-based resources, with the following options: recognition of multilingual text within scanned documents, generation and validation of subtitles in multiple languages, enrichment with information extracted from images and creating semantic links as well as automatic data translation.

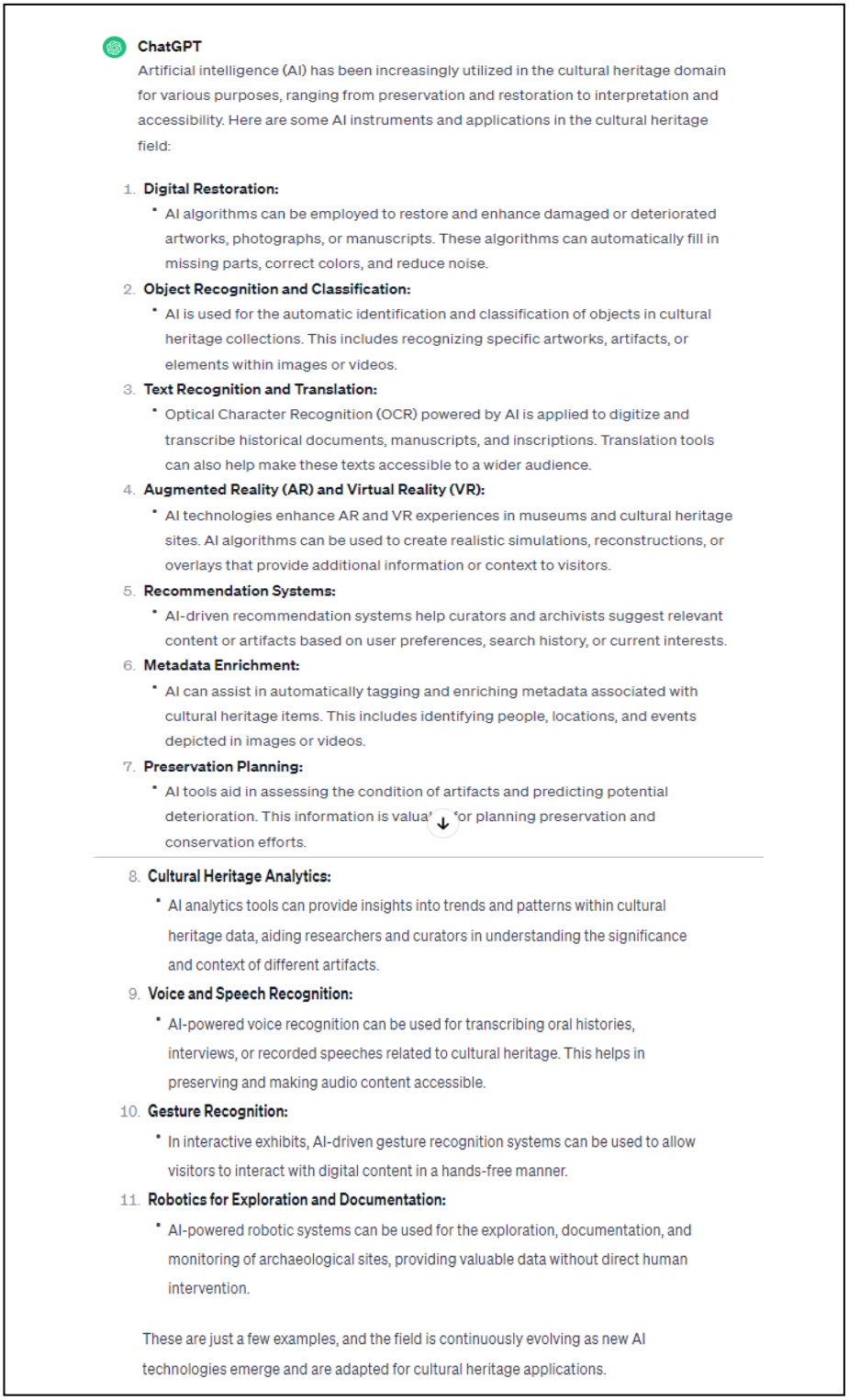
The project mentions that all these options will be accessible online in the common European space regarding the preservation of cultural heritage, and funding is provided through the European DIGITAL Program of the European Union (https://pro.europeana.eu/project/ai4culture-an-ai-platform-for-the-cultural-heritage-data-space).

An innovation in the cultural field was the release of the first book that was illustrated based on AI. The book was released in July 2023 and is entitled "A monster on vacation", author Carmen Ivanov. According to the author, to illustrate this book, it was necessary to generate more than 500 images in Midjourney, a platform that was created to generate images with the help of artificial intelligence, based on a text description (https://www.romaniapozitiva. ro/culture/release-first-book-illustrated-with-artificial-intelligence/).

Figure 4. The first book in Romania „A monster on vacation" illustrated with the help of artificial intelligence

The use of artificial intelligence in culture has countless applications, from mapping urban heritage images using social media data (Bai, N., et all, 2023) to developing cultural heritage preservation techniques to adapt to climate change (Bakirman T., 2023).

To do an imaging exercise, we queried ChatGPT (version 3.5) regarding the state of development of artificial intelligence tools in the field of cultural heritage, generating the following results, shown in Figure 5 below:



ChatGPT

Artificial intelligence (AI) has been increasingly utilized in the cultural heritage domain for various purposes, ranging from preservation and restoration to interpretation and accessibility. Here are some AI instruments and applications in the cultural heritage field:

1. **Digital Restoration:**
   - AI algorithms can be employed to restore and enhance damaged or deteriorated artworks, photographs, or manuscripts. These algorithms can automatically fill in missing parts, correct colors, and reduce noise.
2. **Object Recognition and Classification:**
   - AI is used for the automatic identification and classification of objects in cultural heritage collections. This includes recognizing specific artworks, artifacts, or elements within images or videos.
3. **Text Recognition and Translation:**
   - Optical Character Recognition (OCR) powered by AI is applied to digitize and transcribe historical documents, manuscripts, and inscriptions. Translation tools can also help make these texts accessible to a wider audience.
4. **Augmented Reality (AR) and Virtual Reality (VR):**
   - AI technologies enhance AR and VR experiences in museums and cultural heritage sites. AI algorithms can be used to create realistic simulations, reconstructions, or overlays that provide additional information or context to visitors.
5. **Recommendation Systems:**
   - AI-driven recommendation systems help curators and archivists suggest relevant content or artifacts based on user preferences, search history, or current interests.
6. **Metadata Enrichment:**
   - AI can assist in automatically tagging and enriching metadata associated with cultural heritage items. This includes identifying people, locations, and events depicted in images or videos.
7. **Preservation Planning:**
   - AI tools aid in assessing the condition of artifacts and predicting potential deterioration. This information is valua[illegible]for planning preservation and conservation efforts.
8. **Cultural Heritage Analytics:**
   - AI analytics tools can provide insights into trends and patterns within cultural heritage data, aiding researchers and curators in understanding the significance and context of different artifacts.
9. **Voice and Speech Recognition:**
   - AI-powered voice recognition can be used for transcribing oral histories, interviews, or recorded speeches related to cultural heritage. This helps in preserving and making audio content accessible.
10. **Gesture Recognition:**
    - In interactive exhibits, AI-driven gesture recognition systems can be used to allow visitors to interact with digital content in a hands-free manner.
11. **Robotics for Exploration and Documentation:**
    - AI-powered robotic systems can be used for the exploration, documentation, and monitoring of archaeological sites, providing valuable data without direct human intervention.

These are just a few examples, and the field is continuously evolving as new AI technologies emerge and are adapted for cultural heritage applications.

Figure 5. ChatGPT (version 3.5) on the state of development of AI tools in the field of cultural heritage

Source: Authors' own research

5. Conclusions

The use of artificial intelligence in all fields has become practically a habit nowadays. Its development has brought with it many benefits for all fields, but it has also brought up many issues concerning the ethics, especially in the field of culture, due to the challenges related to copyright legislation. In addition to copyright issues, legislation needs to be improved to clearly regulate usage, security and ethical issues, personal data protection, etc. Analyzing the phenomenon of artificial intelligence, it has been observed that there are also potential security risks and threats regarding artificial intelligence if it is developed in an uncontrolled manner, and steps have already been initiated in terms of the development of increased collaboration between states for the careful analysis of these tools, before that they are accessible. The use of artificial intelligence tools developed at the moment allow first of all savings in terms of costs related to the preservation of cultural heritage, and secondly allow their preservation forever, without being affected by time and natural phenomena, being accessible to everyone, on a large scale, a fact that also contributes to a better knowledge of the culture and traditions of different states.

Although Romania ranks among the last countries in terms of investments in research and development, it cannot be said that our country has not made progress in this field. The interest in the development of artificial intelligence tools was manifested at the level of the responsible authorities through the creation of programmatic documents, which include a series of actions aimed at developing this field, by involving authorities with responsibilities in this field.

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