

across the network, shaping the cultural landscape outside of traditional media. Thus, 4chan serves as a laboratory for experimenting with the boundaries of ethics, language, humour, and social norms.

Ye. Demchenko

**VIRTUAL LEGACY: AI AND IMMERSIVE TECHNOLOGIES
AS A MEANS OF SAVING CULTURE MEMORY**

Є. Демченко

**ВІРТУАЛЬНА СПАДЩИНА: ШТУЧНИЙ ІНТЕЛЕКТ ТА ІМЕРСИВНІ ТЕХНОЛОГІЇ
ЯК ЗАСІБ ЗБЕРЕЖЕННЯ КУЛЬТУРНОЇ ПАМ'ЯТІ**

At present time, with the rapid development of information technologies, the issue of preserving culture heritage has acquired new forms and meanings. It is the evolution of artificial intelligence (AI), virtual reality (VR), and augmented reality (AR) that has resulted in unique opportunities for reconstructing, documenting, and conveying culture memory. Application of these technologies make it possible both preserving physical artifacts and recreating non-material elements of our heritage (languages, rituals, music, and oral traditions) by the use of interactive educational digital experiences.

The concept of virtual legacy refers to the use of digital and immersive technologies to document, visualize, and communicate culture values to a global audience. Unlike traditional museum exhibitions, virtual legacy projects provide dynamic interaction, emotional involvement, and accessibility for people worldwide regardless of time and place. Sometimes visiting museums, exhibitions, or other places of preservation of artifacts may be impossible or dangerous. It is of great importance for countries at war, because not everything can be transported and preserved. For example, the present state of things in Ukraine is not favourable for “history fans” because of the threat of shelling and related security measures. That is why the idea of AI-based reconstruction of the ancient cities, lost works of art, or traditions in danger of disappearing that can be realized in the digital space, seems to be quite attractive. It allows users to experience some historical events in a way that is both educational and emotionally engaging.

The ability of machine learning algorithms to analyze historical archives, recognize patterns in damaged or incomplete artifacts, and automatically restore images or texts can contribute a lot. Old photographs or paintings can serve as a basis for the animation and re-creation of historical figures due to recent advancements in AI. Using deep learning models, it becomes possible to generate facial movements, humanlike voices, and even simulate personality traits described in historical records. For example, an AI expert blogger Alla on Instagram (https://www.instagram.com/reel/C_GRuBfNqhj/) chose portraits of five historical figures and “put all the pieces together” to create an almost perfect picture. The woman worked with the images of such famous Ukrainian personalities as Lesya Ukrainka, Volodymyr Sosyura, Taras Shevchenko, Roksolana, and Bohdan Khmelnytsky. So, Lesya Ukrainka in her video took out manuscripts and began reading them, Volodymyr Sosyura put on glasses, Taras Shevchenko greeted the Ukrainians by waving his hand, Roksolana only showed her face and smiled, and Bohdan Khmelnytskyi raised a mace, supposedly calling for battle. In such a way digital “restoration” may bring the past closer to the contemporary world, enabling future generations to experience historical events in an emotionally vivid and interactive form.

Moreover, image enhancement and restoration technologies based on AI have the potential to revive the forgotten periods of history. By improving the quality of old photos and film materials, researchers can recover details previously lost to time: facial expressions, clothing patterns, or environmental contexts that enrich our interpretation of the past. In addition to visual art, AI is used to reconstruct sculptures, mosaics, architecture, and even digitally recreate historical items that were entirely destroyed. One example of the use of AI is a project to reproduce Rembrandt's paintings, in particular his *Night Watch*. In 2019, a team of specialists from the Rijksmuseum (Amsterdam) used AI to recreate the lost parts of this painting, which were cut off in the 17th century for the convenience of the exhibition. Algorithms analyzed similar works by Rembrandt and studied his style and techniques, which allowed them to create harmonious additions to the original work.

The RePAIR project (Reconstructing the Past: Artificial Intelligence and Robotics meet Culture Heritage) applies artificial intelligence technologies to reconstruct damaged frescoes in the archaeological complex of Pompeii, left after the eruption of Vesuvius in 79 AD and subsequent destruction, for example, during the bombings of World War II. Machine learning algorithms are the tools used by the system to analyze the shape of the fragments, compare color patterns, and identify their proper place in the overall composition. As far as Ukraine is concerned, Uzhhorod Castle possesses a portrait of the Hungarian Countess Christina Csáky, who lived in the fortress in the early 18th century. It was restored by means of artificial intelligence. The original is stored in private collections in Central Europe, that's why public is deprived from the opportunity to examine this masterpiece. The latest capabilities of artificial intelligence were applied to digital restoration of the portrait. The reproduced image was created by the *Ænigmata Historiæ* page specifically for the museum and castle. These restored and animated visual materials can change the way history, literature, and art are studied, introducing an element of interactivity that more deeply engages students and viewers. According to Neil Fleming's VARK model, people perceive information via several sensory channels: auditory, visual, kinesthetic, and digital. While everyone uses all of these channels to some extent, one usually dominates. Research shows that about 60% of people learn through visual techniques, meaning they understand and remember information best when it is presented through images, colors, and diagrams. This makes integrating such technologies in education worthwhile. Thanks to such technologies, history education can become exciting, involving precisely those figures who are central to the topics being studied.

Nowadays, immersive technologies (VR and AR), are further expanding the possibilities for culture legacy preservation and communication. Network services such as virtual museums and 3D exhibitions allow people to explore reconstructed historical spaces, interact with artifacts, and participate in storytelling that connects the past and the present. For example, in the Museum of St. Sophia of Kyiv (Kyiv) one can find a display with a 3D visualization of the appearance of Prince Yaroslav the Wise, who built the shrine. Similarly, in other museums, thanks to technology, artifacts that are missing due to destruction, restoration of historical events, or damaged artifacts are displayed. Through augmented reality, heritage sites can be enriched with contextual layers — information, sounds, and visual reconstructions — turning physical visits into a hybrid educational experience.

The integration of artificial intelligence with virtual and augmented reality technologies also supports inclusive access to culture. Thus, regardless of status or circumstances, there

are 3D museums and exhibitions that can be visited at any time, with the Internet. Those who live far from culture centers, or communities that have lost access to their heritage due to war or migration, can get acquainted with culture artifacts in digital form and see what has been destroyed. Such democratization of heritage corresponds to the global goals of sustainable development and the preservation of culture diversity. This is especially relevant in our time, against the background of current events, because, as we have learned from our own experience, what you have today may disappear tomorrow.

The scientific novelty of this study lies in the conceptualization of artificial intelligence and immersive technologies as culture agents — not just tools for digitization, but active participants in the reconstruction and communication of culture identity. Yes, they play the role of meticulous analyzers of the smallest details. By analyzing large datasets of historical and artistic materials, artificial intelligence systems can reveal hidden culture connections, which allows for new interpretations and comparative studies between civilizations. Adding the possibility of finding connections lost over time.

In summary, virtual legacy represents a transformative paradigm in the global culture space. So, humanity can preserve and reimagine its culture memory by combining the analytical power of artificial intelligence with the emotional depth of immersive technologies. This synthesis of technology and culture not only protects the past but also inspires new forms of creative expression and intercultural understanding in the digital era. This kind of preservation and restoration of “culture memory” can not only protect our history from disappearing over time, but also prevent it, because by spreading it, we attract new people, new admirers, and new stakeholders.