

The ReInHerit Toolkit: Artificial Intelligence and a people-centered approach for cultural engagement

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In this work we present the toolkit developed in the context of the ReInHerit project³. The goal of the project is to improve the communication, collaboration and innovation exchange between museums and cultural heritage sites. The toolkit is a set of innovative applications, instructions and webinars that provide guidelines and prototypes for developing new engaging experiences in the cultural domain. Digital innovation, computer vision and artificial intelligence for cultural engagement have been identified as emergent needs to research and address; the toolkit is part of the ReInHerit *Digital Hub*⁴, designed as the interactive and dynamic space that collects and shares all the resources of the project (webinars, tools, and documentations) for cultural heritage professionals.

The primary and secondary research⁵ conducted by the ReInHerit project highlighted the state of the art of cultural heritage literature and trends in cultural contexts, along with the gaps in cultural institutions and the needs of different audiences. This analysis emphasized the need to adopt a people-centered approach, interacting with visitors in dynamic and powerful ways, offering them participatory learning experiences throughout the visitor's journey (before, during and after). Innovative digital technologies are used to trigger emotions and to create personal connection, personalize visits to the user's needs, enhance playful and social interaction, and share personal experiences. Recent studies outline that museum experience is not linear but cyclical, with emotions playing a critical role at each stage.⁶ Emotions play a role at every stage of the museum experience, from the decision to visit to post-visit enjoyment, and that emotional

³ <https://www.reinherit.eu>

⁴ <https://reinherit-hub.eu>

⁵ Two sets of focus group interviews mapping of the current state of the art in the management of the Cultural Heritage sector and the current use of ICT tools in cultural heritage with museum/heritage site professionals, academic researchers, officers from public authorities/NGOs and ICT professionals, from 12 European countries. Online survey collected 1746 responses by visitors and 506 responses from professionals from 37 European countries. Factsheets with take-aways of primary and secondary research are available here: <https://reinherit-hub.eu/factsheets>

⁶ The last report published on 2021 by LEM -Learning Museum Working Group of NEMO - Network of European Museum Organisations explores the role that emotions play in supporting the learning museum experi-

engagement of visitors is a prerequisite for effective and authentic learning.⁷ The more multisensory, interactive and participatory the museum experience is, the more it will have a lasting impact on the visitor and thus enhance his or her learning on the learning on the subject.⁸ According to recent museum studies, the use of Computer Vision and Artificial Intelligence⁹ technologies in museums is considered as one of its best innovative tools.¹⁰ New technologies and particularly AI/CV tools have the potential to create a stronger relationship between artworks and visitors in the new form of the “phygital museum”, rethinking museums in a diversity of spaces, tools and contexts with a plurality of people and modes of interaction. Interaction and emotional relationship between visitors and the artworks help to make the content more memorable.¹¹

AI/CV tools can help visitors to engage with collections in new ways, developing new insights into collections, enriching museum collections data in a diverse range of ways.¹² Recent recommendation of the EU Committee of Ministers to Member States on the role of culture highlight how digital technologies have the capacity to encourage social interaction and trigger emotions. It is recommended to promote digital and AI-based services considering their impact, fostering collaboration and exchanges between professionals and institutions, through training and awareness-raising activities.¹³ Also due to the COVID-19 pandemic, many museums and other cultural institutions promoted a wide range of digital engagement solutions to maintain a relationship with their audiences.¹⁴ ReInHerit Survey results highlighted visitors prefer to use their smartphones and web-apps without downloading mobile application. More than 50% of the respondents have found mobile applications either distracting or uninteresting. Especially younger do not download museum apps partly because they do not

ence <https://www.ne-mo.org/news/article/nemo/nemo-report-on-emotions-and-learning-in-museums.html>

⁷ Falk J., "The role of emotions in museum-going" 2021 in "Emotions and Learning in Museums" LEM Annual Report by NEMO Network of European Museum Organisations, pp. 55-60

⁸ Falk J. and Dierking L. D., "The Museum Experience Revisited", Left Coast Press Inc., Walnut Creek, CA, 2012.

⁹ Villaespesa E. & Murphy O., "AI: A Museum Planning Toolkit" 2021 edited by "The Museum & AI Network" <https://www.artsmetrics.com/en/ai-a-museum-planning-toolkit/>

¹⁰ Museum Innovation Barometer 2021, Museum Booster <https://museumbooster.com/wp-content/uploads/2021/08/Museum-Innovation-Barometer-2021.pdf>

¹¹ Del Bimbo A. "Emotions in Digital" 2021 in "Emotions and Learning in Museums" LEM Annual Report by NEMO Network of European Museum Organisations

¹² Villaespesa E. & Murphy O. 2021 "This is not an apple! Benefits and challenges of applying computer vision to museum collections, Museum Management and Curatorship", 36:4, 362-383, DOI: 10.1080/09647775.2021.1873827

¹³ Recommendation CM/Rec(2022)15 Adopted by the Committee of Ministers on 20 May 2022 at the 132nd Session of the Committee of Ministers https://search.coe.int/cm/Pages/result_details.aspx?ObjectID=0900001680a67952

¹⁴ Zuanni, C. (August 4, 2020). Mapping museum digital initiatives during COVID-19 <https://pro.europeana.eu/post/mapping-museum-digital-initiatives-during-covid-19>

want to waste memory on their smartphones and devices. Whether they download and use them depends primarily on the type of application offered and the perceived benefits: the higher the visitor interaction and engagement, the more interest in using a mobile application. Thus the toolkit focuses on the benefits of visitors' interactions in order to meet diverse needs and achieve greater visitor satisfaction. To be relevant, the toolkit designs smart solutions to enhance and encourage curiosity, combining playful with interest and inspiring memorable experiences. To be effective, the toolkit aims to enhance and extend user experiences by analyzing and seeking to understand what aspects are desirable, the benefits in use, and the emotional and triggering effects of user engagement.¹⁵

Heritage professionals were asked to choose the technology services and systems currently available in the organization in which they work. The majority (67%) of the museums or cultural heritage sites are equipped with standard ICT tools (Video and audio recording equipment, Web applications, Mobile applications, Online exhibitions, Digitalization systems, Analytics and Feedback tools, Social Media Management tools, Ticketing systems, E-shop), only around 33% of museums and cultural heritage sites use innovative ICT tools (Artificial Intelligence applications, Chatbots, Games and/or gamification, Digital storytelling tools, Digital tools for exhibition planning). All organizations surveyed responded an interest in both digital gaming and immersive experience, and there seems to be a strong need to introduce innovative ICT tools. However, smaller organizations need technical assistance, either guidance or a ready-made package, and they still lack the capacity to incorporate digital tools in their everyday activities. Survey participants also highlighted the urgent need for upgrading and training on the use of innovative technological tools for cultural heritage management and peer to overcome a crucial knowledge gap on digital innovation. According to the focus groups conducted with professionals and experts, it is important to develop the tools so that museum experts and developers can dialogue with visitors, organizing hackathons and workshops. The main goal is to provide not just a tool, but a development process, inviting communities into the creation process and understanding their needs, defining the problem, devising solutions and testing prototypes

CV/AI-based digital and mobile applications are mainly used to interact with the environment in a *playful approach*, based on *gamification* and learning-by-doing techniques. This allows the audience to select objects to interact with, exploiting the “wow” effect to encourage deeper study of the artwork’s content during and after the visit, creating narrative and user-generated content to share on social media. Innovation and transformation is a dynamic process, involving a number of key factors for a sustainable outcome, such as mapping technology tools and human resources to use them, creating a strategy to ensure digital

¹⁵ On teenagers' approach with mobile apps at the museums see also Gaia G, Boiano G., Borda A. - “Engaging Museum Visitors with AI: The Case of Chatbots” , pp 309-329 Cap. 5 in “Museums and Digital Culture”, Springer Nature 2019. Giannini and J. P. Bowen (eds.)

implementation, developing and testing an innovative toolkit in a bottom-up, co-creative approach.

The main target audiences to be addressed by the ReInHerit toolkit are not the common “museum goers”, especially young museum visitors (18-29 years old) as they are more likely to use digital tools in a museum environment. Regarding the cultural institutions, small and medium-sized museums have less funding and skills to produce innovative digital services for cultural heritage management and they most need a sustainable design of digital tools that considers costs, competences, and maintenance; AI and Computer Vision tools are mainly used in large museums and organizations, creating a technology gap with smaller organizations that lack the resources to work with experts in these fields. The development strategy identified *interactive tools* to increase visitor engagement in a user-centered approach through *Mobile-first and web-first apps*, considering mobile devices as first-class targets allows to follow the Bring-Your-Own-Device (BYOD) approach more easily. Releasing the toolkit as open source eases the maintenance issues and reuse of applications by different organizations. The codes for these applications are complemented by additional documentation and associated webinars that can be accessed in the Digital Hub. The apps developed in the toolkit, using AI and CV as founding bases of their use, are:

- **Strike-a-Pose and Face-fit:** these two applications¹⁶ are designed to employ gamification and interaction with an artwork to increase the engagement of the visitors of a museum, based on body pose and face expression recognition using computer vision.
- **Smart Lens:** this app can be used as a lens to observe the details of an artwork, getting the related information. Computer vision is used to recognize which “hotspots” of the artwork are associated with some specific information.
- **Multimedia Chatbot:** this system merges CV and NLP to create modern chatbots for web/mobile interfaces. The idea is to get descriptions and information on artworks using natural language and interacting in a chat, as it has become common in other domains than CH.
- **Smart retrieval:** this is a web application¹⁷ that can be used to provide advanced search functions for multimedia archives. The novelty is in the computer vision part, i.e. the neural network used to associate text describing the desired content of the image and the pixels of the image.
- **Smart video restoration:** this is a web-based application that allows to restore analog archive videos that have been degraded. A novel neural network that uses a multi-frame approach is able to deal with severe tape degradations that result in completely scrambled frames.

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¹⁶ Both apps have been demoed live at ACM Multimedia 2022 obtaining the Best Demo Honourable Mention award for the engaging museum experience they provide.

¹⁷ Demoed live at Computer Vision and Pattern Recognition 2022 conference, obtaining the Best Demo Honourable Mention award.