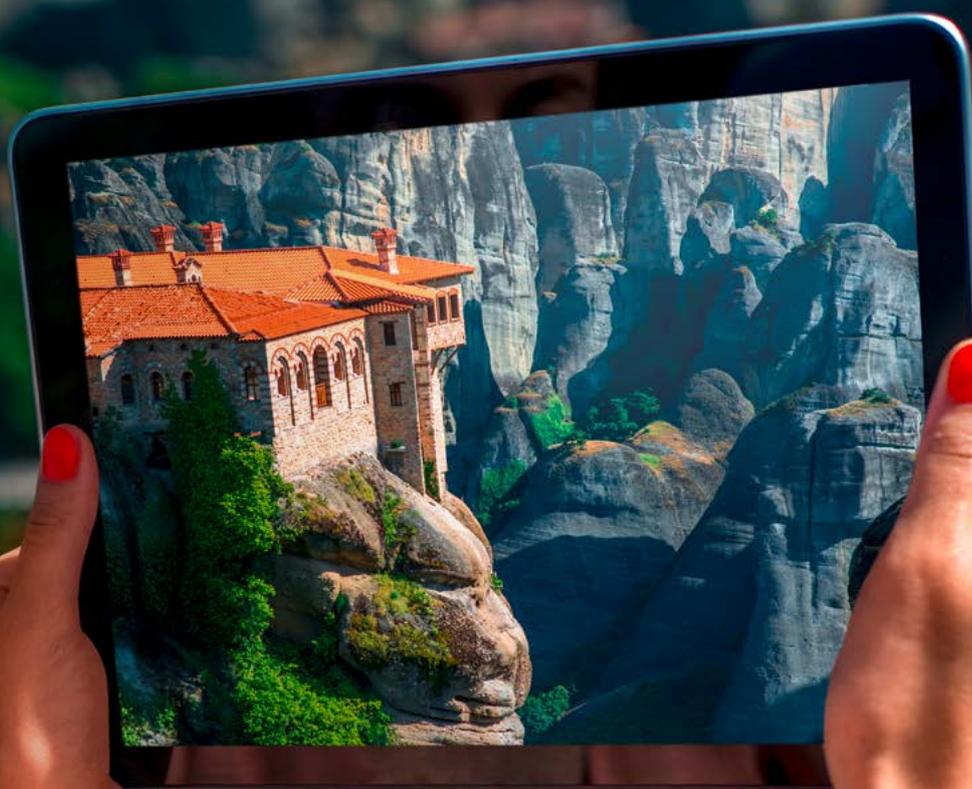




# CORDIS Results Pack on digital cultural heritage

A thematic collection of innovative EU-funded research results

February 2020



## How digital technologies can play a vital role for the preservation of Europe's cultural heritage

# Contents

3

Tool that is an archaeologist's dream

5

Technical innovations help overcome access barriers to cultural spaces for people with disabilities

7

Digital resources encourage citizens to reinterpret European (hi)stories

9

The 'internet of connected historical things' – available anywhere, anytime

11

Emotive digital experiences for museums and cultural sites enliven the past

13

Fostering international relations through museums

15

Redefining the museum experience for the digital age

17

New technology brings Europe's underwater cultural heritage to life

19

Nine European cities open the vault to their historically unique films, photos and texts

21

3D models explore our built cultural heritage through time, onsite and remotely

23

New social media platform ignites passion for cultural heritage

25

Bringing European history to life with the Big Data of the Past

# Editorial

## How digital technologies can play a vital role for the preservation of Europe's cultural heritage

For a continent as culturally rich and diverse as Europe, making sure that valuable cultural assets are available for future generations to enjoy and be inspired by is a major public policy goal. And, as is the case with almost all aspects of modern life, digital technologies are offering solutions to power cultural heritage efforts through the 21st century. In this CORDIS Results Pack, we discover the numerous digital innovations developed by 12 EU-funded projects, with total funding of EUR 33 million, that help to ensure the preservation of Europe's precious cultural heritage.

Whether it's a priceless Dutch Golden Age painting, a ruined Roman Forum surrounded by olive groves on a sleepy Mediterranean hillside or a more modern audiovisual masterpiece of the 20th century, our cultural heritage can be both easily and permanently damaged or, in the worst-case scenario, even destroyed. The numerous natural or human-derived threats to our cultural heritage range from pollution, flooding and wind erosion, through to vandalism and improper maintenance and/or care. The digitisation of cultural heritage is important for the protection, conservation, restoration, research, dissemination and promotion of tangible and intangible cultural assets, coming from all types of cultural institutions (museums, galleries, libraries and archives, monuments and sites).

The possibilities opened up by the increasing advances in digital technologies are impressive and ever-growing. From 3D tech, to artificial intelligence and virtual/augmented reality, these are all being used to not only ensure preservation but also capture the imaginations of younger, digital-native Europeans inspiring the admiration and appreciation for Europe's vast cultural treasures. Concepts such as the Virtual Museum are being eagerly adopted, fuelled by the notion that if one cannot physically get to the museum, then the museum can come to them – only possible through the explosion of digital innovations over the last 20 years.

### How EU policy helps to digitally promote and preserve cultural artefacts

The European Commission through extensive policy, coordination and funding actions supports Member States' cultural policy, with a special emphasis on digitisation and online access to cultural material and digital preservation and curation. Europeana, Europe's platform for digital cultural heritage, works with thousands of archives, libraries and museums across Europe to make cultural content easy to access, use and reuse. It is the only pan-European platform of its kind and plays a key role in making our cultural heritage community stronger. Alongside these efforts, in 2019, 26 European countries signed a [Declaration of cooperation](#) on advancing digitisation of cultural heritage. The Declaration invites Member States to leverage synergies between digital technologies and Europe's cultural heritage in three key areas: (i) a pan-European initiative for 3D digitisation of cultural heritage artefacts, monuments and sites; (ii) enhancing cross-sector, cross-border cooperation and capacity building in the digital cultural heritage sector; and (iii) fostering citizen engagement, innovative use and spillovers in other sectors.

Specifically, through the Horizon 2020 programme, the Commission offers prominent and ongoing support to research and innovation in the cultural heritage domain, with special emphasis on the use of cutting-edge technologies. From 2014-2020, funds through Horizon 2020 towards digital cultural heritage have been around EUR 70 million in total and funding for these initiatives is likely to continue with the advent of the next research and innovation programme, Horizon Europe.

### Proudly exhibiting our projects

In total, this CORDIS Results Pack features 12 projects that are making important contributions to digital cultural heritage efforts.

# Tool that is an archaeologist's dream

Classifying fragments of pottery found during excavations is a time-consuming and expensive business. EU project ArchAIDE developed software to identify the pieces and store them in a database.



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When archaeologists take part in excavations, the pieces of pottery they unearth contain vital clues on how people lived in past eras like the Roman times. But accurately identifying these potsherds can take hours of expert time. EU project ArchAIDE turned to artificial intelligence to develop a mobile and desktop application that can identify ceramics and their origin.

"Half to two thirds of the time currently spent on pottery classification could be saved," says Gabriele Gattiglia, an

archaeologist at the University of Pisa, who coordinated the project to develop the software.

Users take a picture of the pottery fragment they want to identify, adjust the image with a user-friendly tool and send it off for classification. The system uses either a recognition model based on the images and decoration on the pottery or a second model based on shape recognition, which helps identify pottery types, such as to what vessel the sherd belongs.

In a few seconds, the application returns five answers, ordered by a score based on the confidence of the classification system in having found the right answer. Users can click to view information related to the associated type stored in ArchAIDE's database. "In this way it is possible to verify the accuracy of the answers given by the classifier," explains Gattiglia.

## Long-held dream

Gattiglia and archaeologist colleague Francesca Anichini came up with the application idea about 10 years ago when working as professional archaeologists on digs, but they didn't have the funding or the know-how necessary to overcome the technical challenges of developing it. It was in 2014 that they sought EU funding after raising the idea with researcher Roberto Scopigno from the Italian research centre CNR ISTI who thought it was feasible.



*The ArchAIDE applications currently contain only a few ceramic classes, but when that grows it will revolutionise archaeology.*

Archaeologists teamed with engineers and technicians to populate the ceramics database, develop the two neural networks at the core of the system and build the mobile and desktop applications.

To train the network to identify sherds correctly, the developers needed hundreds of thousands of potsherds. The project's archaeologists spent months scouring Europe for them, photographing almost 25 000 fragments. Ingeniously, researchers at Tel Aviv University and the CNR

came up with another way to acquire millions more, creating 3D models of pottery vessels from 2D drawings and artificially breaking them in order to have millions of virtual fragments to train the neural network in how to recognise ceramic shapes.

The software's initial results are impressive: an 83.8 % in top-5 accuracy rate for the appearance-based recognition model and a 62.8 % rate for shape-based recognition.

The partners are now expanding ArchAIDE's database to make the system ever more accurate and to ensure it becomes a go-to resource for researching pottery through the ages. They are also digitising paper catalogues to make them available for purchase within the app, splitting the revenues between the partners and the copyright owners. "The ArchAIDE applications currently contain only a few ceramic classes, but when that grows it will revolutionise archaeology," says Maria Letizia Gualandi, the project's principal investigator.

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### PROJECT

**ArchAIDE – Archaeological Automatic Interpretation and Documentation of cERamics**

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### COORDINATED BY

University of Pisa in Italy

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### FUNDED UNDER

H2020-SOCIETY

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### CORDIS FACTSHEET

[cordis.europa.eu/project/id/693548](https://cordis.europa.eu/project/id/693548)

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### PROJECT WEBSITE

[archaide.eu](https://archaide.eu)



# Technical innovations help overcome access barriers to cultural spaces for people with disabilities

Working with people with disabilities, the ARCHES project developed innovative technological solutions to increase access to cultural artefacts. These included sign language video avatars, tactile artwork reliefs, barrier-free apps for museum visits and games for smartphones and tablets.

When accessing our shared cultural heritage, people's needs defy neat categorisation. With physical or cognitive impairments, traditional categories such as 'blind' or 'learning difficulties' are sometimes too broad and can lead to victimisation.





*ARCHES's participants felt that their voices were heard and for many it was empowering.*

The EU-supported ARCHES project, led by VRVis, focused on a range of access needs, exploiting current and emerging technology to overcome barriers.

in four in-museum participatory research groups in Austria, Spain and the United Kingdom.

Using participatory methods, the researchers created tools including: sign language video avatars (a computer-generated person who offers information in sign language), a museum app, a museum-orientated tablet game (accessible to blind people) and the prototype of a portable visual perception 2.5D printer able to create tactile replications of masterpieces (such as paintings by Bruegel). The interactive nature of these tactile artefacts was further enhanced with the inclusion of surround sound audio reflecting the artefact's content, developed by another EU-funded and collaborating project, PLUGGY.

A patent application has been filed for the relief printer. Additionally the National Weather Forecast Services of Austria is interested in the sign language video avatar.

## Co-creating with the experts

The project adopted a participatory research method which engaged people with a wide range of disabilities and access preferences as co-researchers.

"These participants were the experts on their specific needs and accessibility in general," explains Gerd Hesina, CEO of VRVis. "As all people are different and defy categorisation, it wouldn't have been fair to ask them to label themselves or, worse, for others to."

When technology companies presented designs to users in test sessions, the users fed back their own ideas for features and tools.

The end results included an app that guides a visitor through the museum, accompanied by a game relating to the museum's artwork and a web platform where all the content is accessible.

The project also created 2.5D tactile reliefs from 2D museum artefacts, using a semi-automatic process where digital tools generate a model which is then milled in a durable material, allowing visitors to experience shape, perspective and texture, through touch. This is enhanced by a gesture-controlled multimedia guide including audio/text/sign language description, soundscapes, additional visual material (projections, videos and scans) and on-screen animations. The team exploited emerging technologies where they could, for example developing sign language avatars.

These technologies were tested for design, layout, accessibility settings, content and user-friendliness by more than 200 participants

## Beyond access issues

ARCHES's inclusive technology helps ensure not only public access to cultural institutions, but more importantly, that all EU citizens are able to more easily participate in political, cultural and social activities.

"It's not just about improving access to services, but also ensuring that rights and needs are recognised. This involves embracing differences and changing the way we work," says Hesina. "Overall, ARCHES's participants felt that their voices were heard and for many it was empowering."

Currently, apps and games from the project are available for download from Google Play and the Apple Store, for use in the participating museums and at home. The multimedia guide will be on display at the six participating museums (Museo Thyssen-Bornemisza in Spain, Victoria & Albert Museum in the United Kingdom, KHM-Museumsverband in Austria, Museo Lázaro Galdiano in Spain, The Wallace Collection in the United Kingdom and Museo de Bellas Artes de Asturias in Spain) and is being marketed to European museums alongside the tactile reliefs – over the coming months it will be shown at four different exhibitions in Austria alone.

A guidebook for museums was published in three languages, outlining how to set up and run a participatory research group. The sign language avatar is being further developed under the EU-supported SiMAX project and will be taken forward by the company SignTime (after the project's end date of February 2020) to improve multilingual signing-gestures.

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### PROJECT

**ARCHES – Accessible Resources for Cultural Heritage EcoSystems**

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### COORDINATED BY

VRVis in Austria

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### FUNDED UNDER

H2020-SOCIETY

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### CORDIS FACTSHEET

[cordis.europa.eu/project/id/693229](https://cordis.europa.eu/project/id/693229)

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### PROJECT WEBSITE

[arches-project.eu](https://arches-project.eu)



# Digital resources encourage citizens to reinterpret European (hi)stories

Recognising that cultural heritage plays a vital role in forging identities, CROSSCULT created interactive experiences, making cross-border connections among cultures, citizens and physical venues to encourage reflection and reinterpretation.

History and cultural heritage are often viewed as being irrelevant to daily life, perceived as processes where the memorisation of facts is paramount and expert interpretations offered are unassailable truths.

The EU-supported CROSSCULT project allowed people to create their own interpretations, demonstrating that history and cultural heritage are not immutable but evolving social phenomena.



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The project developed reflection tools which revealed hidden associations between locations, artefacts, concepts and people across Europe. These were developed as part of the CROSSCULT services Platform and the CROSSCULT Knowledge Base, which held the mobile applications and software currently targeted for market launch.

## The reflection tools for smarter venues

The CROSSCULT Platform offers flexible software services and a toolkit for cultural heritage professionals to develop their own customised applications (including profiling, personalisation, association discovery and narrative creation). The platform hosts four ecosystems offering solutions for the exploration of large multi-thematic venues, for connecting different small/medium ones, for connecting physical and digital cultural items, social media and trending topics and, lastly, for location-aware urban discovery of culture heritage. The platform also integrates a Knowledge Base, which links digital collections across sites.

The project crowdsourced its technology development through its 'living lab', a forum which engaged specialists and the public. This allowed a range of voices to be heard, making the effort more inclusive as it took into account considerations such as disability needs.

The team conducted four pilots. At London's National Gallery, paintings showed different aspects of European history, connecting concepts, places and people, while also assisting visitors in navigating the venue. The second pilot connected four archaeological locations in Greece, Italy, Portugal and Spain, exploring the therapeutic use of water in antiquity with visitors collaborating in dedicated games. The Archaeological Museum of Tripolis in Greece had its collection digitally enriched with items from museums around the world, exploring the place of women in society, past and present. Finally, two UNESCO heritage cities (Luxembourg and Valetta) were linked under the theme of population movement, using location-based and crowdsourcing technologies.

"These showed that mobile application experiences, designed using our platform and using reflective narratives, can successfully engage cultural heritage visitors in cross-border thinking and historic reinterpretations," says Kate Jones, team member.

## Supporting social cohesion

By increasing access to culture that explores social issues such as health or migration, while revealing cross-border connections,

CROSSCULT helps people re-examine their common past and explore their individual and group identities. Creating surprising links and questioning assumptions – with users guided by narratives that reflect on 'my gender identity', 'my local identity', 'my European identity', etc. – could help increase social cohesion and respect for difference.

Currently the platform is available on demand under an Affero General Public License and three of the four pilot mobile applications are available from the Google and Apple stores. With CROSSCULT's assets of interest for marketing, education, tourism or smart cities, the team are currently investigating the formation of a legal entity to manage the commercial potential of some of the assets.

"We are investigating opportunities within and beyond Europe. Prototype developments already underway in Ecuador and Egypt point to the global direction they would like to go in. Alongside this, we want to further explore associated technology used in the project such as social media, especially the role of influencers, and the crowdsourcing of content," says Martín López Nores, a CROSSCULT team member.



*Mobile application experiences, designed using our platform and using reflective narratives, can successfully engage cultural heritage visitors in cross-border thinking and historic reinterpretations.*

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### PROJECT

**CROSSCULT – Empowering reuse of digital cultural heritage in context-aware crosscuts of European history**

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### COORDINATED BY

Luxembourg Institute of Science and Technology in Luxembourg

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### FUNDED UNDER

H2020-SOCIETY

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### CORDIS FACTSHEET

[cordis.europa.eu/project/id/693150](https://cordis.europa.eu/project/id/693150)

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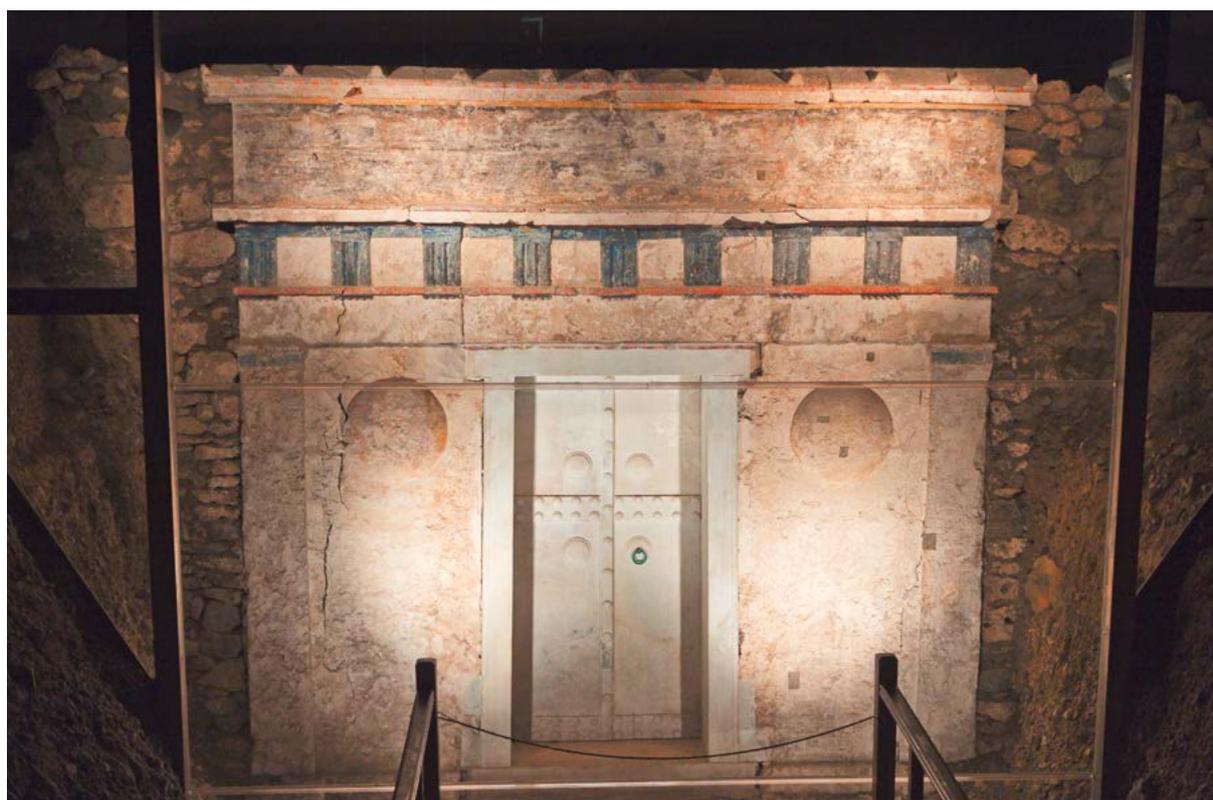
### PROJECT WEBSITE

[crosscult.eu](https://crosscult.eu)



# The 'internet of connected historical things' – available anywhere, anytime

By enabling simple and cost-efficient 3D capture of resources, from the big to the small, from full historical sites to handheld artefacts, DigiArt allows the public to access and explore cultural heritage interactively.



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Whilst European countries benefit from a rich cultural heritage, there is much variety and diversity in how this resource is documented and presented. Furthermore, current technologies – such as for 3D model generation – usually rely on dedicated software, based on complicated algorithms and requiring specialist skill-sets.

The EU-supported DigiArt project created a common platform for the 'internet of connected historical things', available on any web-enabled device. To complement this, DigiArt developed bespoke software capable of processing data post-capture for 3D model generation, with one mouse click – opening up the field to non-technical users. The project also developed manipulation

techniques, based on semi-automated tools, allowing curators to curate their own content.

Augmented Reality (AR) and Virtual Reality (VR) demonstrations were presented in three case studies, including showcasing narrative techniques to linked artefacts across regions or time, in informative and entertaining scenarios.

## Tools for digging deeper

DigiArt developed a technological toolset for use by museums to create a revolutionary way of viewing and experiencing artefacts and sites. These tools cater for the complete digitisation process of data capture, data processing, story building, 3D visualisation and 3D interaction.

During the project, experiments were conducted to test and verify the most appropriate 3D reconstruction techniques for small artefacts (3D scanners) as well as various drones and camera systems for large-scale scanning of archaeological sites.

The system performed semantic analysis on the resultant 3D representations, using specially developed algorithms, to extract information and then form informative hyperlinks between artefacts, creating a web of meaning.

Another key aspect to the project's technology was the Story Telling Engine. This user-friendly web interface allows curators to customise 3D models of objects or actual sites by defining the behav-

ours experienced by users, as well as uploading supplementary information to be communicated by video or avatar, for example.

"The system presents the artefact, linked to its context, in an immersive display with virtual and/or augmented reality elements. Linkages and information are superimposed over the view of the items, which are supplemented with audio recordings offering more historical detail," says project coordinator, Andy Shaw.

## Developing the 'virtual tours'

The project successfully trialled demonstration scenarios in three museum settings, offering a range of artefacts and posing different challenges. It was installed for 3D models of the Palace of Aigai, Macedonia, a virtual museum containing the Liverpool John Moores University anthropology bone collection and in Scladina cave near Namur, Belgium.

In the case of Scladina Cave, the AR has already been installed for visitors, supplemented by the Story Telling Engine explaining how this area evolved down the years.

The technology was developed as open access, with the 3D models available on the DigiArt website as well as on GitHub. Instructions on how to make a 3D scanner and the software required to operate it are also available online.

"The technology can help people with disabilities explore cultural sites where physical access might not be available. Additionally, researchers can use the open access 3D models to further their work," says Shaw. "We are now looking to expand into more scenarios such as developing sensing technology for preservation work."



*The system presents the artefact, linked to its context, in an immersive display with virtual and/or augmented reality elements.*

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### PROJECT

**DigiArt – The Internet Of Historical Things  
And Building New 3D Cultural Worlds**

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### COORDINATED BY

Liverpool John Moores University in the United Kingdom

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### FUNDED UNDER

H2020-SOCIETY

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### CORDIS FACTSHEET

[cordis.europa.eu/project/id/665066](https://cordis.europa.eu/project/id/665066)

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### PROJECT WEBSITE

[digiart-project.eu](https://digiart-project.eu)



# Emotive digital experiences for museums and cultural sites enliven the past

The adaptation of advanced immersive technologies, such as augmented reality, combined with storytelling techniques, brings cultural heritage sites and events alive, not only for heads but also for hearts.



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Despite being key to an audience's engagement with cultural heritage, many institutions tend to employ narrative devices to only narrowly communicate the research findings of subject experts, often leaving the audiences' engagement relatively emotionless.

The EU-funded EMOTIVE project developed immersive storylines using a range of technologies including virtual reality (VR),

augmented reality (AR) and mobile phone apps, to create more 'emotive' cultural site visits. Alongside innovations in image enhancement, mobile app components and 3D reproductions – powered by an easy-to-use authoring tool – the project helps enhance an audience's understanding and imaginative experience of cultural sites and content (both onsite, offsite and hybrid combinations).



EMOTIVE's range of prototype tools and applications was showcased at the project's final public demonstration in October last year at the Hunterian Museum at the University of Glasgow. Guests were able to use the project's prototypes to explore the Çatalhöyük Neolithic archaeological site in Turkey and the Antonine Wall built as a coast to coast defence in Scotland by the Roman's in AD 142. An example of the immersive experience was one VR environment which had four characters from Roman Britain to guide visitors around the museum's Antonine Wall displays whereby they could learn more about it by using mobile phone AR apps.

After evaluating the technologies, the team were satisfied that the Authoring Tools were effective and stable for complex mixed reality storytelling for onsite and virtual experiences. The trials also highlighted the importance of social interaction in making the past relevant to the present, as the tools sparked dialogue offering different perspectives and challenging stereotypes, and helped users of the technology confront complex social issues.

*Regardless of age, location or preservation state, cultural sites are seedbeds not just of knowledge, but of emotional resonance and human connection.*

## The storytelling engine and digital media assets

Heritage experts can use the EMOTIVE Authoring Tools to collaborate and create interactive onsite digital storytelling audience experiences themselves, which visitors can download to smart devices. These tools cater for varying levels of technical expertise from amateur to expert to produce a range of experiences, from simple text-based presentations to advanced multi-user AR games.

The Storyboard Editor enables writers to set up and test storylines and simple digital experiences, while the Visual Scenario Editor defines more complex storylines and designs diverse experiences for both single users and groups, using audiovisual assets created themselves or sourced from the internet. Visual programming allows these authors to create advanced storytelling experiences by adopting already available modules which can be used 'out-of-the-box', meaning they do not need to have programming skills.

Offsite digital experiences can be augmented with a Mixed Reality Plugin which uses advanced Image-Based Rendering (IBR) techniques to turn typical 2D photography into fully immersive virtual environments. The technology even allows visitors to physically explore historical artefacts, as replicas can be cast and, with the help of the Object Tracking Plugin, brought back to their original state through a VR headset.

For remote access, the Floor Plan Editor can create virtual representations of sites by merging 360° photographs and publishing them in a web environment, viewable through EMOTIVE's Web Experiencing System, combined with the original onsite storytelling.

"Regardless of age, location or preservation state, cultural sites are seedbeds not just of knowledge, but of emotional resonance and human connection," explains project coordinator, Hara Stefanou. "Drama-based narratives, containing careful reference to a site's cultural content, can transform heritage experiences, encouraging repeat visits and ongoing interaction."

## Linking with lived experiences

Currently, some modules of the EMOTIVE Authoring Tool are available to cultural institutions through a dedicated portal for a trial period, with the team planning to implement their approach in additional cultural sites.

EMOTIVE's storytelling techniques could be adopted for education purposes, using historical empathy to exercise skills such as decision-making and critical reflection. Refinements are planned so that the technology can be used more widely, for example in tourism, entertainment or marketing. With a business plan already developed, the team is searching for additional funding to advance the technology and reach market readiness, with a view to making the Storyboard Editor and the Visual Scenario Editor available first.

As well as having knock-on effects in the local, regional and national cultural economies, this Virtual Museum approach will attract a skilled workforce who can harness the potential of these cutting-edge digital tools.

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### PROJECT

**EMOTIVE – Emotive Virtual cultural Experiences through personalized storytelling**

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### COORDINATED BY

EXUS Software Ltd in the United Kingdom

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### FUNDED UNDER

H2020-SOCIETY

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### CORDIS FACTSHEET

[cordis.europa.eu/project/id/727188](https://cordis.europa.eu/project/id/727188)

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### PROJECT WEBSITE

[emotiveproject.eu](https://emotiveproject.eu)



# Fostering international relations through museums

Museums can play a big role in promoting cooperation between European and Latin American and Caribbean countries finds an EU research project.



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What better way to foster international relations than through museums? That's the thinking of the EU-funded EU-LAC-MUSEUMS project, which aims to use community museology as a means of promoting cooperation between European and Latin American and Caribbean countries.

"Understanding museums as tools for sustainable community development is one of this project's key priorities," says Karen Brown, a researcher at the University of St Andrews, the project's coordinating partner. "By researching state-of-the-art initiatives in museums and community

empowerment and implementing actions in partner countries, we aim to transform individual lives within museum communities – and beyond."

The EU-LAC-MUSEUMS team is comprised of leading academics, museum professionals and policy makers elected by the International Council of Museums (ICOM). These include the Pontifical Catholic University of Peru, the National Museum of Costa Rica, the Austral University in Chile, University of the West Indies, the University of Valencia (Spain), and the National Archaeology Museum in Lisbon, Portugal.

## Collaboration is key

The underlying premise of the project is a belief that community-based museums allow under-represented communities to stake a place in history, as well as contribute to environmental sustainability and community empowerment. Building on this belief, the project is conducting a comparative analysis of small- and medium-sized rural museums and their communities in Europe, Latin America and the Caribbean and, based on this, developing an associated history and theory.

"Though many miles lie between us, working together as a bi-regional team has brought about a substantial increase in cultural understanding," explains Brown. "This has been achieved through such collaborative initiatives as an art exhibition, the launch a dedicated YouTube channel, publishing a manual on museum best practices, and conducting international research

into such issues as traditional water heritage practices in southern Spain and northern Peru."

The project also created a virtual museum, which is currently being used to support a series of 3D workshops held across 20 museums in nine different countries. The workshops aim to help museum professionals better lever-

age the power of digital technologies. To date, over 350 people have participated in these workshops, resulting in the creation of three mobile apps, 32 virtual tours, 180 3D models, 400 photospheres and 24 hours of video.

However, for Brown, one of the highlights of the project so far has been a bi-regional youth exchange between Costa Rica, Portugal and Scotland. The cultural exchange involved monthly workshops to engage young people with their heritage, as well

as a physical exchange where 24 young people were able to live and learn in one of the participating countries.

"We deliberately selected remote and island locations so participants could share and experience new cultures, including music and dance, along with understanding new challenges like over-tourism and depopulation," says Brown. "It was truly a transformative experience for everyone involved."

## Right on track

Despite some setbacks due to unexpected natural disasters and political instability in the participating countries, the EU-LAC-MUSEUMS project remains on track. As it enters its final phase, the team is now focused on ensuring the project's legacy.

"We would like to see other countries benefit from our work, so we are exploring the idea of launching travelling exhibitions and creating a shared database," adds Brown.



*By researching state-of-the-art initiatives in museums and community empowerment and implementing actions in partner countries, we aim to transform individual lives within museum communities – and beyond.*

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### PROJECT

**EU-LAC-MUSEUMS – Museums and Community: Concepts, Experiences, and Sustainability in Europe, Latin America and the Caribbean**

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### COORDINATED BY

University of St Andrews in the United Kingdom

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### FUNDED UNDER

H2020-SOCIETY

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### CORDIS FACTSHEET

[cordis.europa.eu/project/id/693669](https://cordis.europa.eu/project/id/693669)

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### PROJECT WEBSITE

[eulacmuseums.net/index.php](https://eulacmuseums.net/index.php)

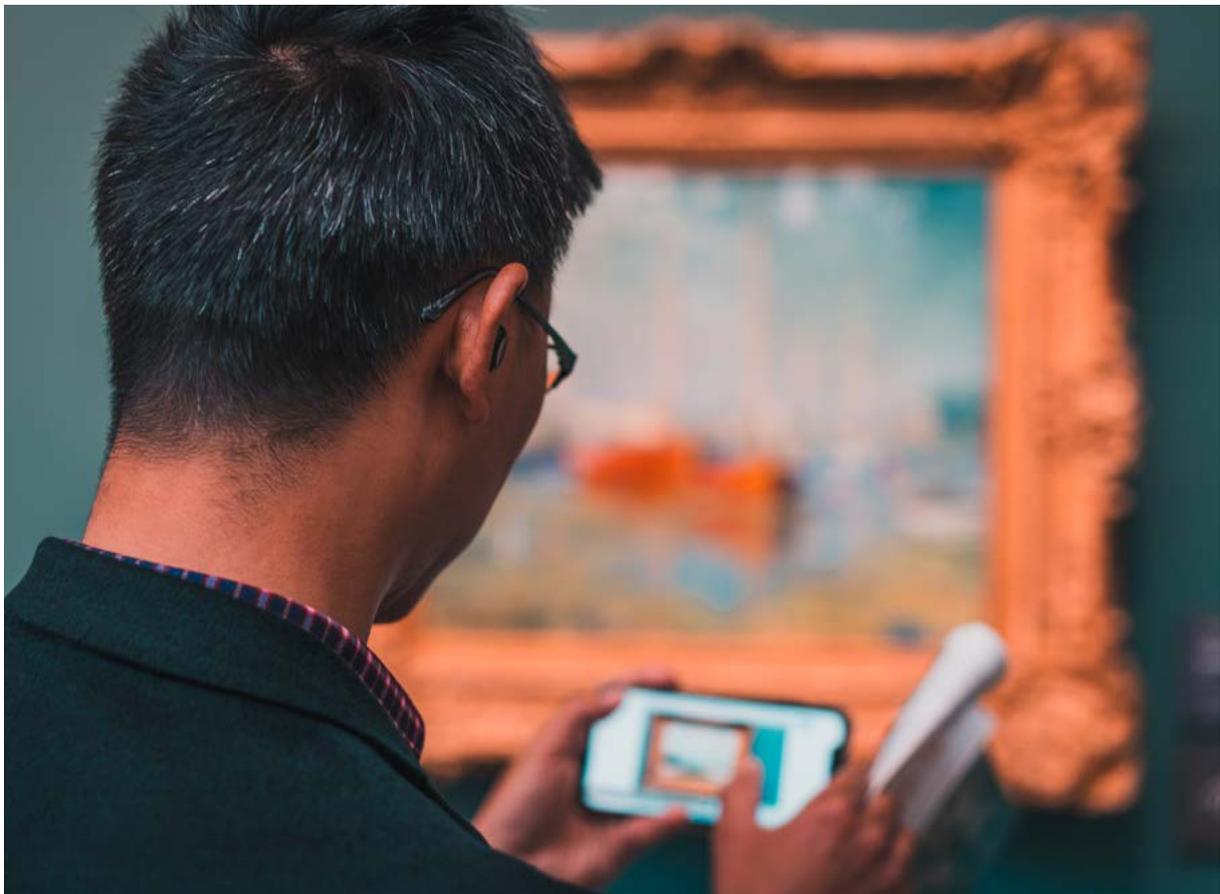


# Redefining the museum experience for the digital age

Researchers have been using mobile applications and other modern digital technologies to create more meaningful and interpersonal museum experiences.

Digital technologies have the potential to redefine museums, opening the door to an array of new ways to connect with visitors. A possible approach is to create hybrid experiences that utilise digital technology capable of enriching a physical visit to museums.

"The challenge with developing virtual museums is establishing meaningful user experiences that allow for personal, complex and emotional encounters with art and cultural heritage," says Anders Sundnes Løvlie, an associate professor at the IT University of Copenhagen and coordinator of the EU-funded GIFT project.



GIFT – a consortium of leading researchers, museums and artists – set out to provide curators and designers with the tools they need to develop meaningful, interpersonal museum experiences. “Museums are social spaces, where social interactions sometimes overshadow the content and context of exhibitions,” explains Løvlie. “Therefore, it was important for our project to pay close attention to these social, shared experiences.”

## The GIFT Box

Many museums have used technology to create digital reproductions of physical exhibitions. The GIFT project differs in that it looked at using mobile applications to enhance the experience of a visitor who is physically inside a museum.

“We call it hybrid virtual museum experiences because we’re not that interested in strapping virtual reality glasses on people and shutting them inside a digital world,” says Løvlie. “By combining the physical space with the digital, we aim to create nuanced and complex experiences rather than just digital reproductions of physical exhibitions.”

The result of this effort is the GIFT Box, a portfolio of free, open-source tools and methods that museums can use to enrich the physical experiences of their visitors. For example, the Gift App lets visitors use their smartphone to create a digital gift for someone they care about.

The tools are geared towards helping museums generate, strengthen, test and prioritise ideas for digital enrichment. For example, VisitorBox Ideation Cards is a printable card game that curators can use to brainstorm ideas for digital experiences, whereas the ASAP Map encourages users to develop a shared understanding of these ideas. From there, designers can leverage the Experiment Planner to plan and test their ideas, along with mapping out a clear path towards implementation.

The GIFT Box also contains several apps that allow visitors to become museum curators. Artcodes are customisable and scannable markers that help visitors add digital content to a

physical exhibit. There’s also an app that lets visitors create interactive 3D models of various museum works and exhibits.

## Increasing curiosity and engagement

By providing the tools and framework for building meaningful personalisation of digital cultural heritage, the GIFT project is redefining the museum experience for the digital age. “By enabling more engaging hybrid virtual/physical museum experiences, we increase citizen curiosity and engagement,” adds Løvlie. “Furthermore, because our unique hybrid format makes physical visits more engaging and attractive, it also contributes to economic growth through ticket and digital sales.”

The Gift App is now offered at the Munch Museum in Oslo, Norway. The project’s 3D and augmented reality tools were also used to create an ongoing exhibition at the National Museum in Belgrade, Serbia. A number of other museums have also expressed interest in using the project’s tools.



*By enabling more engaging hybrid virtual/physical museum experiences, we increase citizen curiosity and engagement.*

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### PROJECT

**GIFT – Meaningful Personalization of Hybrid Virtual Museum Experiences Through Gifting and Appropriation**

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### COORDINATED BY

IT University of Copenhagen in Denmark

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### FUNDED UNDER

H2020-SOCIETY

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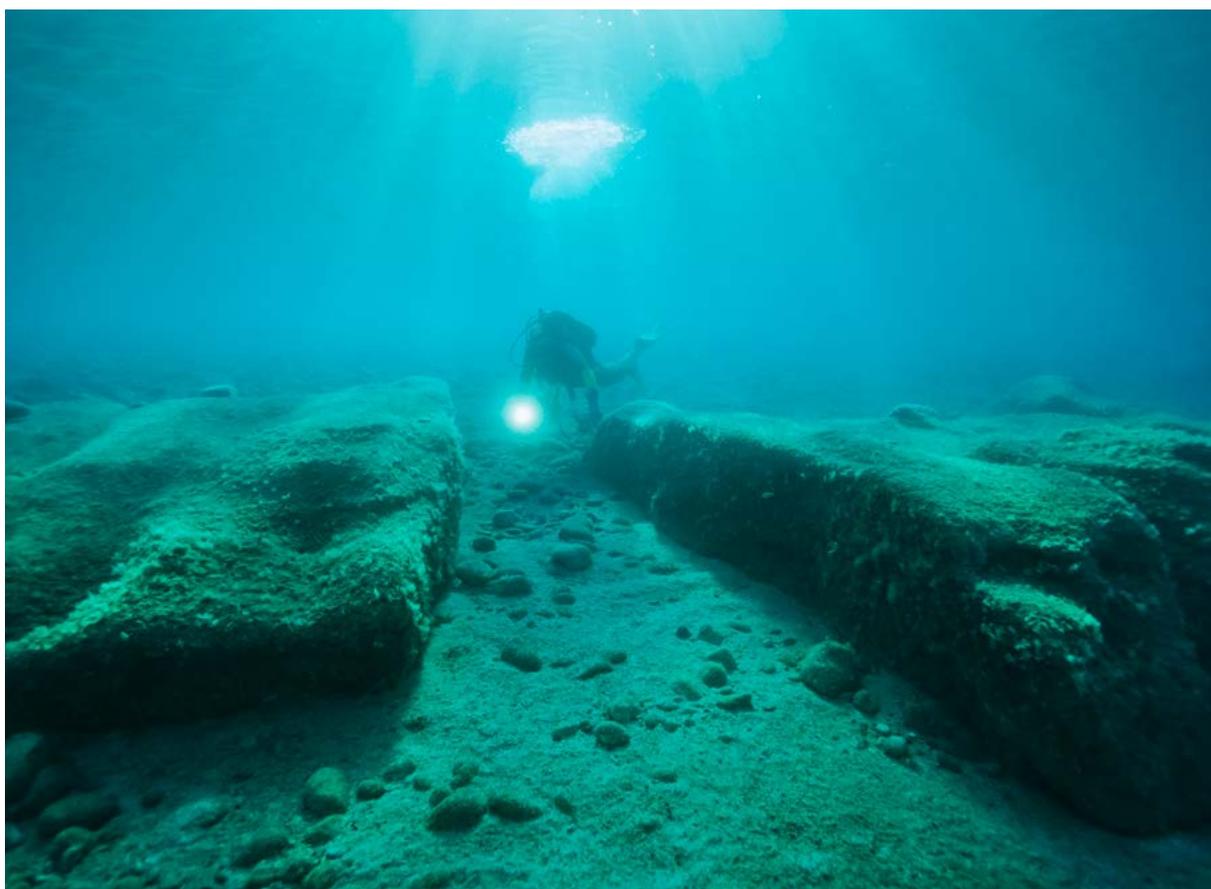
### PROJECT WEBSITE

[gifting.digital](https://gifting.digital)



# New technology brings Europe's underwater cultural heritage to life

Immersive technologies such as augmented and virtual reality are being leveraged to make Europe's underwater cultural heritage more accessible.



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Europe's unique cultural heritage and history isn't limited to dry land – it can be found underwater too. Whether it be an ancient Roman resort, the wreck of a trading ship or sunken treasures, the sea floors are often littered with unique cultural artefacts. Unfortunately, because they sit at the bottom of the sea, these sites have been grossly underappreciated by the public.

"No matter how important an underwater cultural heritage site may be, even if you are a professional diver, most of it is inherently unreachable," says Dimitrios Skarlatos, an associate professor of civil engineering and geomatics at the Cyprus University of Technology and iMARECULTURE project coordinator.

By leveraging new immersive technologies like augmented and virtual reality, the EU-funded iMARECULTURE project is helping make Europe's underwater cultural heritage more accessible to the general public.

## Enhancing underwater visits

According to Skarlatos, the project sets out to not only make underwater cultural heritage more tangible, but also educate the public – and divers as well – about why properly preserving this unique heritage is important.

As to the latter, the project developed an innovative augmented reality underwater tablet that serves as a virtual guide. The device enhances visits to these sites and explains the importance of ensuring their preservation.

Take for example the sunken city of Baiae. Some 2 000 years ago, this was a fashionable Roman resort. Today its luxurious villas sit on the sea floor just off the coast of Naples. "The iMARECULTURE tablet makes a dive to this site even more engaging by providing 3D renderings of what these ruins would have looked like back in Roman times," explains Skarlatos. "Using these augmented reality renderings, the diver can virtually explore the ancient city of Baiae in its past splendour."

Skarlatos notes that once fully developed, the tablet will offer several promising applications. In addition to enhancing underwater visits, it could also be used as a scientific tool, allowing underwater researchers of any discipline to take notes and geo-position photos and the locations of new discoveries, or superimpose information about a specific find in real time. "The possibilities are really endless," adds Skarlatos.

## Igniting our curiosity

As to the general public, the project uses virtual reality as a valorisation tool to make underwater sites more accessible via virtual visits, serious games and interactive museums. These

so-called 'dry visits' are then made available via mobile phones, virtual reality headsets, holographic screens and more.

"Using captured images, data and videos, the general public can explore such unique underwater sites as the Xlendi and Mazotos shipwrecks without ever leaving land," says Skarlatos. "There's even a feature that lets the viewer experience what these sites would look like if they were scuba diving."

Project researchers are currently exploring how to best add new sites to the virtual reality visits. "People are naturally attracted to the unknown and out-of-reach places," says Skarlatos. "With the help of emerging technologies, we can convert this curiosity into a passion for preserving Europe's plethora of cultural heritage sites – both those on land and under the sea."



*With the help of emerging technologies, we can convert curiosity into a passion for preserving Europe's plethora of cultural heritage sites – both those on land and under the sea.*

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### PROJECT

**iMARECULTURE – Advanced VR, iMmersive serious games and Augmented REality as tools to raise awareness and access to European underwater CULTURAL heritagE**

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### COORDINATED BY

Cyprus University of Technology in Cyprus

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### FUNDED UNDER

H2020-SOCIETY

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### PROJECT WEBSITE

[imareculture.eu](https://imareculture.eu)



# Nine European cities open the vault to their historically unique films, photos and texts

The history of several European cities is now more accessible with multimedia and digital technology thanks to the I-Media-Cities project.

Europe's cities are steeped in history. Unfortunately, too often this history is hidden away in archives and accessible only to researchers. But with new digital technologies, this is starting to change.



The EU-funded I-Media-Cities project has launched a revolutionary platform that uses audiovisual material to let everyone discover and interact with the history of nine European cities. "I-Media-Cities strives to be a cross-border, cross-language platform for studying the history and development of major European cities," says Davy Hanegreefs, head of digital strategy and innovation at the Royal Belgian Film Archive and I-Media-Cities project coordinator. "By opening the vaults of historically unique films, photographs and texts that were previously not accessible, we created a one-of-a-kind, interactive experience."

The project is a collaborative effort between nine film archives, six research institutions, two large digital centres of expertise, and an expert in business models from Copenhagen, Stockholm, Frankfurt, Brussels, Vienna, Turin, Barcelona, Bologna and Athens.

## Improving accessibility to European cultural heritage

Project researchers set out to create new approaches to researching historically significant digital content, make European cultural heritage more accessible, and stimulate collaborations between archives and researchers. The result of this work is imediacities.eu, an online platform where all types of users can access and view more than 10 000 digitised films and photographs



*By opening the vaults of historically unique films, photographs and texts that were previously not accessible, we created a one-of-a-kind, interactive experience.*

uploaded by the project's partners. The system not only allows users to search and view these works, they can also add their own information by tagging a specific frame or photo. There's even an option to visit 3D virtual exhibitions on certain subjects.

The platform uses a state-of-the-art machine learning tool that allows it to analyse uploaded films and photographs and automatically segment the films into shots. It can also search every frame for the presence of more than 80 concepts (i.e., train, dog, person, etc.). In one test case, the platform used the machine learning tool to automatically identify and label several famous city landmarks.

The platform also has a special environment for scientific and academic researchers. "Images and movies like those found on the I-Media-Cities platform are the most popular and publicly sought-after form of digitised cultural heritage objects, yet they are hardly studied in a scientific context," adds Hanegreefs. "By creating this platform and making thousands of films and photographs readily available, we have opened the door to the research community."

Speaking of the research community, for many of the project's partners, this was the first time they worked with machine learning tools. "These tools will play an increasingly important role in research, and having the chance to get hands-on-experience with the technology was immensely valuable."

## Adding new users

Although the project is now finished, the I-Media-Cities team continues to expand the platform's reach to additional EU cities, and is always looking for new archival partners to join the platform. "To join, all you have to do is contact our team and upload your films and images," says Hanegreefs. "It's as simple as that!"

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### PROJECT

**I-Media-Cities – Innovative e-environment for Research on Cities and the Media**

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### COORDINATED BY

Royal Belgian Film Archive in Belgium

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### FUNDED UNDER

H2020-SOCIETY

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### CORDIS FACTSHEET

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### PROJECT WEBSITE

[imediacities.eu](https://imediacities.eu)



# 3D models explore our built cultural heritage through time, onsite and remotely

European identity grows from its citizens having access to, and understanding of, the region's cultural heritage as it evolves over time. INCEPTION developed enriched 3D models of built and social environments through time, for more engaging interaction with this heritage.

While 3D reconstruction has greatly enhanced audiences' experience of cultural heritage, it is still hampered by the limitations of the equipment involved, storage capabilities and

cost-effectiveness. By adapting currently available technology, the EU-supported INCEPTION project has redefined how 3D modelling can render our cultural heritage more accessible.



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INCEPTION used advanced Building Information Modelling (BIM) techniques, to create next-generation 3D models of artefacts and environments, accompanied digitally by contextual technical and historical information. These models were integrated into the project's web platform which users could access using virtual reality (VR) and augmented reality (AR) tools. Using interactive features such as Time Machine, users can experience the dynamic reconstruction of buildings through time.

## 3D modelling: capture, processing and end-use

When it comes to modelling buildings or archaeological sites, 3D laser scanners and photogrammetry (including drones and robots) usually provide the initial data sources for BIM models. INCEPTION captures this data and uploads it to its platform where it is accompanied by geospatial coordinates to position objects or sites of interest (such as historical buildings) on a world map.

The models are then enriched with explanatory digital information (such as historical documents) corresponding to physical features or points in time.

Using a standard web browser, users from scholars to members of the public can search the database of models (free of charge) using keywords, as well as spatial and multi-criteria queries. They can then interact with the model either onsite, using VR tools, or remotely via the web platform. Users can select a period of time or a specific physical feature to explore and the appropriate version of the model will appear.

For example, with the model of the Istituto degli Innocenti (one of the project case studies) in Florence, Italy, by selecting one of its nine semicircular arches, users can learn not only about its terracotta designs (by Andrea della Robbia), but also about the building's original function as an orphanage, to which the relief design alludes.

INCEPTION's open standards and workflows for 3D cultural heritage modelling (known as 'Open H-BIM') allows the technology to be adopted by wider cultural heritage efforts. Users can upload basic models to the system and then update them

over time, like a wiki. Additionally, all the platform's information is encoded according to the semantic web's standards, making it machine readable.

The INCEPTION process was tested across nine Demonstration Cases from six European partner countries (Croatia, Cyprus, Greece, Italy, the Netherlands and Spain) selected for their range of contexts, differing in typology, physical dimensions, state of conservation and main purpose (tourism, conservation, etc.).

"The groundbreaking technical core of the INCEPTION platform redefines the significance of 3D heritage models, positioning them as knowledge aggregators," says Roberto Di Giulio, project coordinator.

"The immediate next step is to populate the platform with more 3D models from European cultural heritage buildings and sites, linking materials such as video, images, texts, audio files, etc. from important institutional sources, such as Europeana" adds Di Giulio.

A spin-off company, called INCEPTION s.r.l., is to be incubated at the University of Ferrara and will bring the technology to the market, with future iterations digitising cultural heritage in the face of threats due to natural disasters, pollution, mass tourism, terrorism and vandalism.



*The groundbreaking technical core of the INCEPTION platform redefines the significance of 3D heritage models.*

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**PROJECT**

**INCEPTION – Inclusive Cultural Heritage in Europe through 3D semantic modelling**

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**COORDINATED BY**

University of Ferrara in Italy

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**FUNDED UNDER**

H2020-SOCIETY

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**PROJECT WEBSITE**

[inception-project.eu/en](https://inception-project.eu/en)



# New social media platform ignites passion for cultural heritage

By leveraging the power of social media, PLUGGY aims to promote and protect European cultural heritage.



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According to the EU-funded PLUGGY project, Europe's cultural heritage shouldn't be confined to museums and books. Instead, it should be tangible and available for citizens to directly interact with and even help transform. That is why they are working on PLUGGY, which will become Europe's first social networking platform completely dedicated to cultural heritage.

"There is a general lack of technological tools for promoting local traditions, customs and history to a wider European – or even global – audience," says Angelos Amditis, director of the Institute of Communication and Computer Systems (ICCS) and coordinator of the PLUGGY project. "To 'plug' this gap, this project uses social media to help facilitate the sharing of personalised experiences with and knowledge of local cultural heritage."

## Curators, influencers and advocates

Given the popularity and ubiquity of social media, project researchers decided to leverage this medium to engage with people directly. To do this, the project is developing open source solutions that developers can use to create a range of social applications. Currently, these include the PLUGGY3D Suite (for creating augmented reality experiences), PLUGGY Pins (for creating guided tours), Games Hunter (for creating interactive games), and PlugSonic Suite (for creating soundscapes).

"The PLUGGY project empowers European citizens and, specifically, developers, to become actively involved with their cultural heritage, not only as observers, but as curators, influencers and advocates too," says Amditis. "PLUGGY's combination of tradition and technology is key to keeping this heritage alive for generations to come."

By facilitating the crowdsourced telling of important cultural heritage stories, PLUGGY is laying the groundwork for building virtual exhibitions and interactive virtual museums on specific cultural heritage topics.

"Once fully operational, citizens, social and cultural groups, businesses, museums and governments will be able to use the PLUGGY platform to share their love of local culture in a fun and entertaining way," adds Amditis.

## Gaining traction, going global

The platform is currently available in beta form and in multiple languages, and project researchers are busy working to extend and improve the PLUGGY experience. "We designed this platform to meet the needs of its users, so supporting developers with additional applications and functions remains a priority," says Amditis. "The consortium is also committed to further enriching the platform with new stories and pushing our networks and contacts to do the same."

Even as a work-in-progress, PLUGGY is already gaining attention. For example, the Games Hunter will soon be commercially available in Italy. It is also serving as the basis for new applications for museums in Greece. Furthermore, the PlugSonic Suite, which has proved invaluable for creating unique audio experiences for the visually impaired, will be made available via the Apple App Store.

Although originally targeting the European market, Amditis says that the project has its sights set further: "We see PLUGGY as having the potential to become a global platform. By sharing our cultures and customs, we hope to bring people around the world closer together."



*The PLUGGY project empowers European citizens and, specifically, developers, to become actively involved with their cultural heritage, not only as observers, but as curators, influencers and advocates too.*

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### PROJECT

**PLUGGY – Pluggable Social Platform for Heritage Awareness and Participation**

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### COORDINATED BY

Institute of Communication and Computer Systems in Greece

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### FUNDED UNDER

H2020-SOCIETY

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### CORDIS FACTSHEET

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### PROJECT WEBSITE

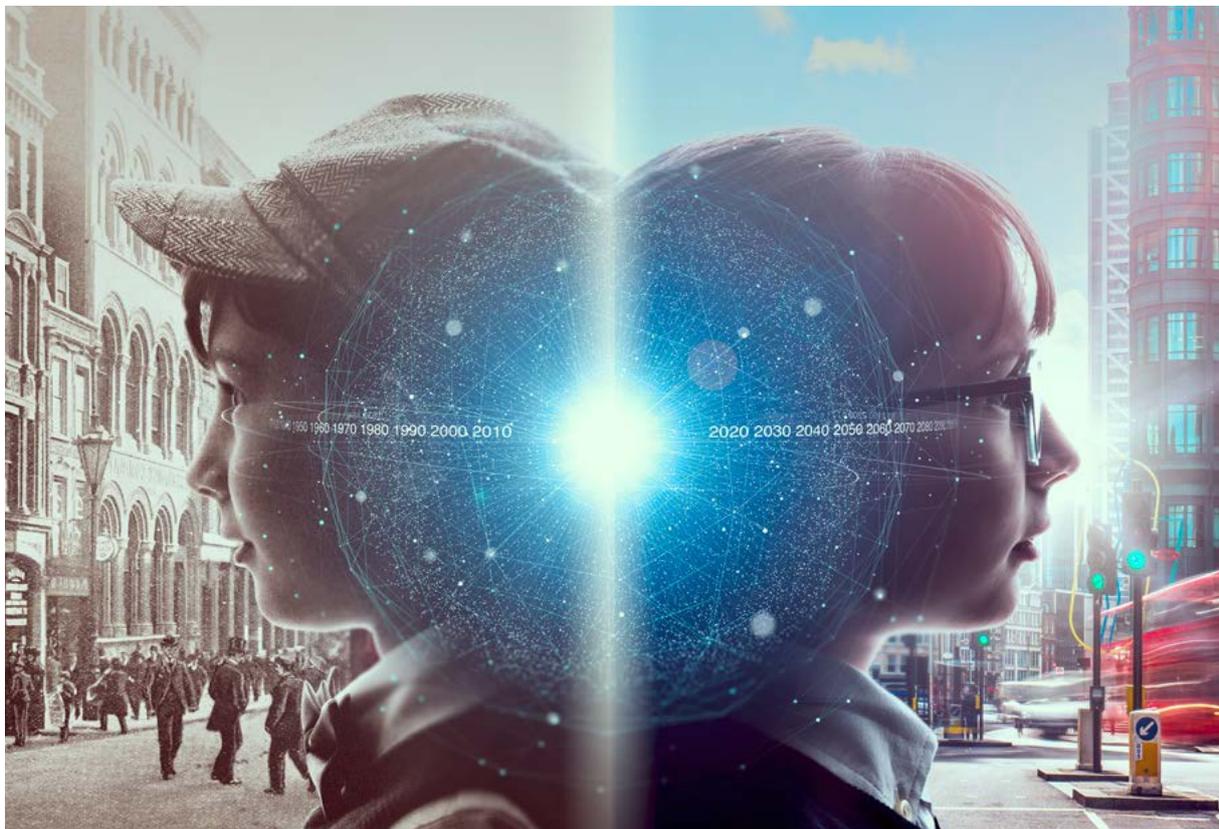
[pluggy-project.eu](https://pluggy-project.eu)



# Bringing European history to life with the Big Data of the Past

Emerging technology has the power to transform history and cultural heritage into a living resource. The Time Machine project will digitise archives from museums and libraries, using Artificial Intelligence and Big Data mining, to offer richer interpretations of our past.

An inclusive European identity benefits from a deep engagement with the region's past. The Time Machine project set out to offer this by exploiting already freely accessible Big Data sources.



© Time Machine Organisation

EU support for a preparatory action enabled the development of a decade-long roadmap for the large-scale digitisation of kilometres of archives, from large museum and library collections, into a distributed information system. Artificial Intelligence (AI) will play a key role at each step, from digitisation planning to document interpretation and fact-checking.

Once embedded, this infrastructure could create new business and employment opportunities across a range of sectors including ICT, the creative industries and tourism.

## Building a 4D world

In the next 3 years (2020-2023), Time Machine will develop a platform which includes a Search Engine for access to information about past people and places. In 2018 the team demonstrated a prototype which enabled a search of handwritten historical text, queries of iconographic material and simple temporal browsing of historical maps.

Digitisation is currently conducted across over 20 'Local Time Machines', in cities including Amsterdam, Budapest, Antwerp and Paris. Still nascent, these comprise a community of researchers, entrepreneurs and patrimonial experts. The platform is now being revamped using International Image Interoperability Framework (IIIF) technology, fully compatible with Europeana standards, a project collaborator.

Time Machine will build a 4D (3D plus time) engine which 'recreates' past cities; an

achievement dependent on AI to unlock key supporting technologies for so-called 'Mirror Worlds' – digital twins of our cities on which machine-readable information can be attached. These will be accessible from mobile phones or through specific Augmented Reality interfaces.

"As new information platforms, Mirror Worlds are likely to play a role as important as the web or social networks do now. Ten years from now, our ambition is to have developed the first European 4D Mirror World," says Frédéric Kaplan, project coordinator.

In parallel, Time Machine plans the creation of digitisation hubs to accelerate the transformation of public and private assets and archives into accessible digital resources. The roadmap also plans the deployment of a fleet of vehicles to speed up digitisation efforts.

## Consolidating historical knowledge

AI and Big Data, when paired with human expertise, opens the possibility of critically reconsidering existing historical interpretations. For instance, last year, an AI-based document reading system, when applied to several hundred thousand art history documents, identified more than a thousand artworks with conflicting attributions.

"Nobody knew about this as only a machine could systematically scan such a large quantity of data," recalls Kaplan. "Similar large-scale checking will be deployed for millions of European buildings. This is the beginning of a consolidated version of historical knowledge."

With more than 400 institutions now supporting Time Machine, the roadmap includes the development of various platforms for scholarship, education, libraries, museums and archives, creative industries, tourism, urban planning and land use. Each created for specific use cases with the collaboration of relevant professional bodies.

The team are now finalising their Request for Comments (RFC) publication platform, which will form the backbone of their design strategy, inspired by the collective design of the internet. In March 2020, the preparatory action will publish the results of work to date, including their development, scaling and sustainability plan, with the public version of the platform and the roll out of the infrastructure.



*Ten years from now, our ambition is to have developed the first European 4D Mirror World.*

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### PROJECT

**Time Machine – Big Data of the Past for the Future of Europe**

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### COORDINATED BY

Swiss Federal Institute of Technology Lausanne in Switzerland

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### FUNDED UNDER

H2020-FET

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### PROJECT WEBSITE

[timemachine.eu](https://timemachine.eu)



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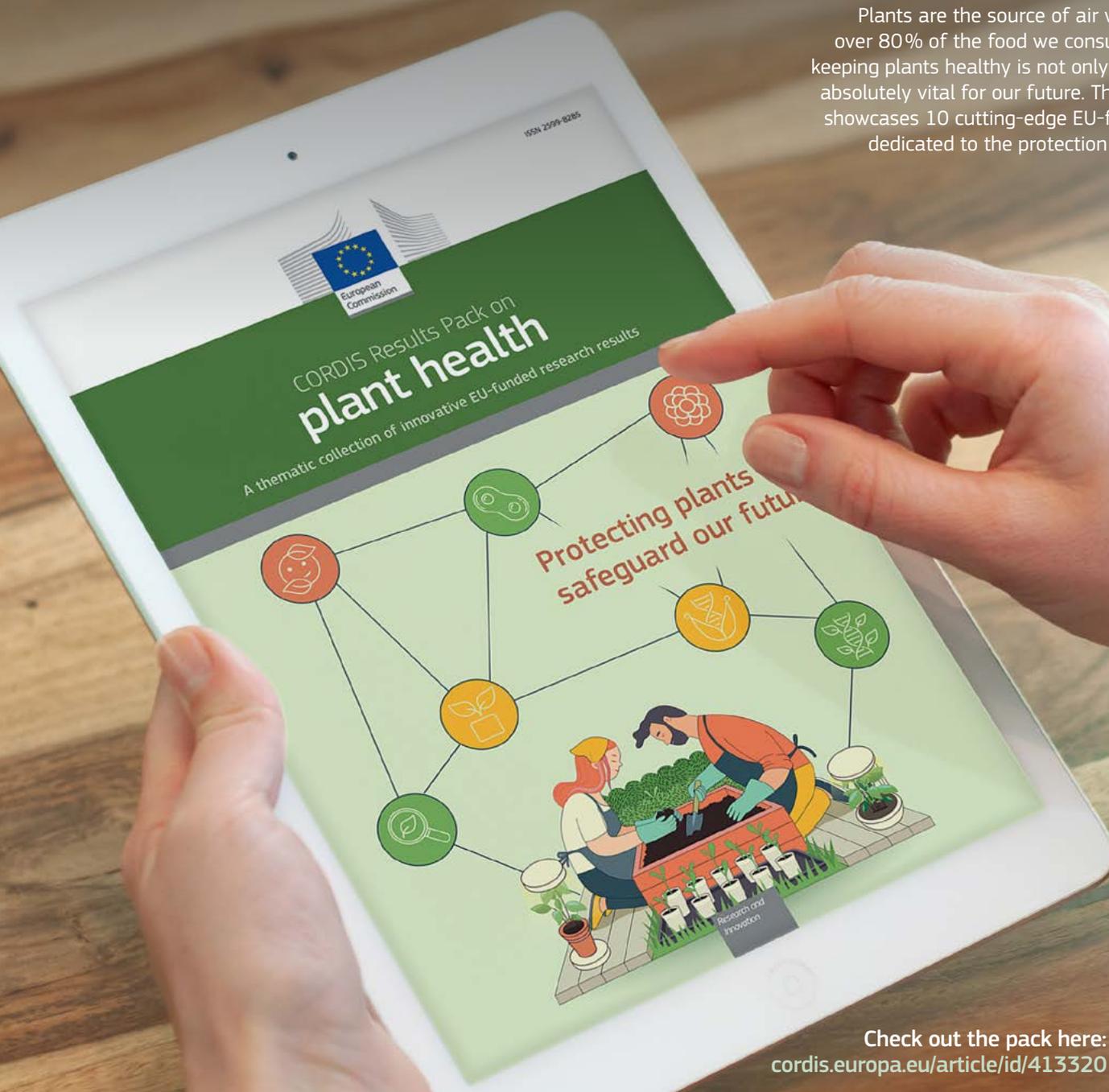
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Plants are the source of air we breathe and over 80% of the food we consume. Therefore, keeping plants healthy is not only important, it is absolutely vital for our future. This Results Pack showcases 10 cutting-edge EU-funded projects dedicated to the protection of plant health.



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