



CORDIS Results Pack on digital cultural heritage

A thematic collection of innovative EU-funded research results

February 2021



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

Research and
Innovation

**SECOND
EDITION**

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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. This updated CORDIS Results Pack unveils the numerous digital innovations developed by 16 EU-funded projects, with total funding of EUR 45 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.

In 2020, with the help of experts, the Commission also finalised the [10 basic principles for 3D digitisation](#) of tangible cultural heritage, an important guideline for heritage professionals wanting to digitise their content. And of course, COVID-19 has clearly highlighted the need to improve online access to cultural heritage – indeed, whilst many European cultural institutions had to close, many have since bounced back by expanding their digital offerings.

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 will likely continue with the launch of the next research and innovation programme, Horizon Europe.

Proudly exhibiting our projects

In total, this CORDIS Results Pack features 16 projects (12 from the original Pack published in 2020 and four new projects added in 2021) that are making important contributions to digital cultural heritage efforts.

This updated CORDIS Results Pack is dedicated to the memory of Ellen Schraudolph-Gautier, whose passion was to drive the field of cultural heritage forward and to ensure that all of these research projects were a resounding success.

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.



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. ArchAIDE (Archaeological Automatic Interpretation and Documentation of cERamics) 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 breakthrough in using artificial intelligence in this way was possible due to an impressive consortium from Germany, Israel, Italy, Spain and the United Kingdom. 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 results are impressive: an 83.8% in the 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 even more accurate and to ensure it becomes a go-to resource for researching pottery through the ages. Following the end of the project in May 2019, the MAPPA Lab, a research unit of the University of Pisa, has been pursuing this goal, adding new catalogues and activating national and international collaboration with institutions and research groups around the world to improve the system.

"The ArchAIDE applications currently contain only a few ceramic classes, but when that grows it will truly revolutionise archaeology," concludes Maria Letizia Gualandi, the project's principal investigator.



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

PROJECT

ArchAIDE – Archaeological Automatic Interpretation and Documentation of cERamics

COORDINATED BY

University of Pisa in Italy

FUNDED UNDER

Horizon 2020-SOCIETY

CORDIS FACTSHEET

cordis.europa.eu/project/id/693548

PROJECT WEBSITE

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.



The EU-supported ARCHES (Accessible Resources for Cultural Heritage EcoSystems) project, led by VRVis, focused on a range of access needs, exploiting current and emerging technology to overcome barriers.



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

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

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.

PROJECT

ARCHES – Accessible Resources for Cultural Heritage EcoSystems

COORDINATED BY

VRVis in Austria

FUNDED UNDER

Horizon 2020-SOCIETY

CORDIS FACTSHEET

cordis.europa.eu/project/id/693229

PROJECT WEBSITE

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 (Empowering reuse of digital cultural heritage in context-aware crosscuts of European history) project allowed people to create their own interpretations,

demonstrating that history and cultural heritage are not immutable but evolving social phenomena.

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.



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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.



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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.

PROJECT

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

COORDINATED BY

Luxembourg Institute of Science and Technology in Luxembourg

FUNDED UNDER

Horizon 2020-SOCIETY

CORDIS FACTSHEET

cordis.europa.eu/project/id/693150



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 (The Internet Of Historical Things And Building New 3D Cultural Worlds) 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 behaviours 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.

PROJECT

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

COORDINATED BY

Liverpool John Moores University in the United Kingdom

FUNDED UNDER

Horizon 2020-SOCIETY

CORDIS FACTSHEET

cordis.europa.eu/project/id/665066



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 (Emotive Virtual cultural Experiences through personalized storytelling) 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.

PROJECT

EMOTIVE – Emotive Virtual cultural Experiences through personalized storytelling

COORDINATED BY

EXUS Software Ltd in the United Kingdom

FUNDED UNDER

Horizon 2020-SOCIETY

CORDIS FACTSHEET

cordis.europa.eu/project/id/727188

PROJECT WEBSITE

emotiveproject.eu

Fostering international relations through museums

An EU research project demonstrated the important role that museums play in promoting cooperation between European and Latin American and Caribbean countries. Researchers also developed recommendations on positioning museums as a catalyst for sustainable development, social inclusiveness and community empowerment.



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What better way to foster international relations than through museums? That's the thinking of the EU-funded project EU-LAC-MUSEUMS (Museums and Community: Concepts, Experiences, and Sustainability in Europe, Latin America and the Caribbean), which used community museology as a means of promoting cooperation between the European Union and the Community of Latin American and Caribbean States (CELAC).

"Museums hold an unequalled responsibility to communicate the shared historic, cultural, political and economic ties between Europe, Latin America and the Caribbean," says Karen Brown, a researcher at the University of St Andrews, the project's coordinating partner. "This project leveraged museums' enormous capacity for reaching all levels of community – from towns to remote villages – and serving as neutral spaces for building social cohesion and reconciliation."

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

Museums as a catalyst for change

With the goal of using museums as a means of increasing EU-CELAC relations, the project began by researching the concepts and experiences of sustainability in museums and communities from both regions. This research involved 135 community workshops held in all partner countries. During these workshops, nearly 28 000 participants shared their experiences and thoughts on making museums a catalyst for sustainable development, social inclusiveness and community empowerment.

"From this research, we developed new proposals for redefining community museums in ways that accentuate their social role and potential for local development," adds Brown.



Museums hold an unequalled responsibility to communicate the shared historic, cultural, political and economic ties between Europe, Latin America and the Caribbean.

Incorporated into the ICOM's new resolutions, the project's proposals will help guide the organisation's future actions and missions. "This resolution marks a moment of change within the ICOM and its understanding of the value of community museums for

society," say the presidents of ICOM Europe and ICOM Latin America and Caribbean Countries in a joint statement.

Significant action

In addition to its focus on policy, the EU-LAC-MUSEUMS project was also about taking action. In fact, its in-person, social, media and digital engagement efforts have reached well over 1 million people in 154 countries.

To further transcend borders, the project also created an innovative virtual museum. This museum recently supported a series of 3D workshops held across 20 museums in nine different countries. "These workshops helped museum professionals better leverage the power of digital technologies," notes Brown.

Another highlight was a bi-regional youth exchange that the project organised between Costa Rica, Portugal and Scotland. The cultural exchange involved monthly workshops that engaged 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.

"The exchange is another great example of how this project turned what we've learned about museum community development into concrete actions for further growing EU-LAC relations," adds Brown.

The project is currently working to expand the project's impact to all potential users, museum professionals and decision makers. "We would like to see other countries benefit from our work, so we are furthering the reach of our travelling exhibitions and shared database," concludes Brown.

PROJECT

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

COORDINATED BY

University of St Andrews in the United Kingdom

FUNDED UNDER

Horizon 2020-SOCIETY

CORDIS FACTSHEET

cordis.europa.eu/project/id/693669

PROJECT WEBSITE

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 (Meaningful

Personalization of Hybrid Virtual Museum Experiences Through Gifting and Appropriation) 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."



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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."



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

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.

PROJECT

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

COORDINATED BY

IT University of Copenhagen in Denmark

FUNDED UNDER

Horizon 2020-SOCIETY

CORDIS FACTSHEET

cordis.europa.eu/project/id/727040

PROJECT WEBSITE

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.



© Angelo Giampiccolo, Shutterstock

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 (Advanced VR, iMmersive serious games and Augmented REality as tools to raise awareness and access to European underwater CULTURAL heritagE) 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.



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.

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."

PROJECT

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

COORDINATED BY

Cyprus University of Technology in Cyprus

FUNDED UNDER

Horizon 2020-SOCIETY

CORDIS FACTSHEET

cordis.europa.eu/project/id/727153

PROJECT WEBSITE

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 (Innovative e-environment for Research on Cities and the Media) 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 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!"



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.

PROJECT

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

COORDINATED BY

Royal Belgian Film Archive in Belgium

FUNDED UNDER

Horizon 2020-SOCIETY

CORDIS FACTSHEET

cordis.europa.eu/project/id/693559

PROJECT WEBSITE

imediacities.eu



3D models explore our built cultural heritage through time, on-site 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 (Inclusive Cultural Heritage in Europe through 3D semantic modelling) project has redefined how 3D modelling can render our cultural heritage more accessible.



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

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 heritage sites, 3D laser scanners and data capturing technologies (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 for models uploaded onto the platform (free of charge) using keywords, as well as spatial and multi-criteria queries. They can then interact with the model either on-site, 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') allow 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.

The project has resulted in an innovative start-up company, INCEPTION Srl, accredited as a spin-off of the University of Ferrara. The company exploits the outcomes of the EU-funded project by empowering public administrations, museums, site owners, etc. with software solutions based on the INCEPTION Core Engine. It provides solutions for managing, visualising and archiving 3D or BIM models and all related digital documents, aggregated by semantic technologies.

PROJECT

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

COORDINATED BY

University of Ferrara in Italy

FUNDED UNDER

Horizon 2020-SOCIETY

CORDIS FACTSHEET

cordis.europa.eu/project/id/665220

PROJECT WEBSITE

inception-project.eu/en

SPIN-OFF WEBSITE

inceptionspinoff.com

Historical newspaper research methods get an overhaul

Searching through historical newspapers for a research paper or thesis used to be tedious, if not downright hopeless. Thanks to NewsEye's automated text recognition, search, semantic enrichment and processing tools, such work is now getting much easier.



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We often look at history books as the most valuable recollections of society's past struggles and breakthroughs. But as far as details go, nothing really beats the millions of events, stories and names discussed in newspapers every single day. As such,

newspapers are an integral part of our cultural heritage. They need to be digitalised and stored – which explains why libraries across Europe have been stepping up their efforts and will continue to do so over the coming years.

But current digitalisation methods are not without their drawbacks. As Antoine Doucet, professor and researcher at the University of La Rochelle, points out: "Much remains to be done for the collections to be truly available to ordinary citizens and humanities scholars, so that they can benefit from the new possibilities of digital methods for their research."

There are several problems at hand, which Doucet has been aiming to overcome with funding under the NewsEye (A Digital Investigator for Historical Newspapers) project: The low quality of digitised newspapers, the lack of adequate search and analysis tools, and the dizzying amount of information available which calls for new ways to help users find what they're looking for.

The first issue is therefore tied to the fact that most library collections were digitised decades ago. Applying optical character recognition (OCR) to such archives often results in poor-quality output. This is problematic, as users of historical newspapers need high-quality text recognition results in order to search, find and browse through relevant content.

NewsEye overcomes this problem by combining advanced technologies for text recognition, layout analysis, article separation and other related tasks. Furthermore, Doucet and his team developed semantic tools that enrich the text with data such as named entities (people, companies, countries, etc.) or events. These can then be linked to external data sources like Wikidata, which helps provide more accurate search results that even cross language barriers.

Enhanced research potential

"Semantic enrichment provides powerful search capabilities and supports further analysis of the content. The applied methods are strongly based on statistical approaches and avoid dependencies on external dictionaries or high-level linguistic analysis. This makes our tools applicable to a wide range of languages," Doucet says. This is indeed a great step forward. Users of historical newspapers need effective tools to index and search newspaper content in various ways to discover topics, trends and patterns. Such tools were largely non-existent before NewsEye, and those that existed failed to cope with the noisy, low-quality OCR results.

This brings us to the third problem: State-of-the-art tools for text analysis are not adapted to the needs of historical newspaper users. NewsEye fills this gap with Dynamic Text Analysis tools. These support interactive queries to discover different viewpoints, subtopics or trends concerning the selected topic,

the named entity, the newspaper, the timeframe, etc. This all provides insights into the newspaper collection in contextualised and comparative manners.

Last but not least, users interested in historical questions and needing to deal with billions of items will benefit from the project's so-called Personal Research Assistant. Doucet explains: "The Assistant will autonomously investigate newspaper content on behalf of the user and will report on findings which it assesses as potentially interesting. It will also provide a transparently presented rationale for how the assessment was made so the findings can be understood and verified by the user."

All NewsEye tools are available on the project website. Many of them are well on their way to being fully exploited and sustained, and Doucet intends to eventually make them useful beyond the scope of newspaper research. Funding has already been granted for such exploration, in the context of further projects at the regional, national and European level.



The applied methods are strongly based on statistical approaches and avoid dependencies on external dictionaries or high-level linguistic analysis. This makes our tools applicable to a wide range of languages.

PROJECT

NewsEye – A Digital Investigator for Historical Newspapers

COORDINATED BY

University of La Rochelle in France

FUNDED UNDER

Horizon 2020-SOCIETY

CORDIS FACTSHEET

cordis.europa.eu/project/id/770299

PROJECT WEBSITE

newseye.eu



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 (Pluggable Social Platform for Heritage Awareness and Participation) 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. This is why PLUGGY was developed, becoming 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 PLUGGY project coordinator. "To 'plug' this gap, the project used 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 has developed 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," adds 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 laid the groundwork for building virtual exhibitions and interactive virtual museums on specific cultural heritage topics.



The PLUGGY project empowers European citizens and, specifically, developers to become actively involved with their cultural heritage.

"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," explains Amditis.

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."

PLUGGY has thus gained a lot of attention and even its Facebook audience has grown markedly, as have the number of individual stories on the platform. In particular, the Games Hunter application is now commercially available in Italy. The PLUGGY Pins app is now being used for generating self-guided tours and the PlugSonic Suite has proven invaluable for creating unique audio experiences for the visually impaired. Finally, PLUGGY3D is still evolving, with its increased functionality being improved upon by the day.

Although originally targeting the European market, Amditis adds that the project has its sights set further afield: "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."

Gaining traction, going global

The platform is 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

PROJECT

PLUGGY – Pluggable Social Platform for Heritage Awareness and Participation

COORDINATED BY

Institute of Communication and Computer Systems in Greece

FUNDED UNDER

Horizon 2020-SOCIETY

CORDIS FACTSHEET

cordis.europa.eu/project/id/726765

PROJECT WEBSITE

pluggy-project.eu



New digital tools help preserve silk's – and part of Europe's – history

Silk is more than a soft textile. It's a symbol of happiness and luxury. It's also deeply rooted in European history, to the point where it has become an integral part of our cultural heritage. The trouble is, that heritage is now seriously endangered.

It was a huge topic of conversation in France in 2017. The 'Musée des Tissus', a museum showcasing over 4 500 years of textile history, was almost shut down due to a funding shortage before being saved at the very last moment. It wasn't an isolated case. All across Europe, major silk museums have become almost as

fragile as the textile they've been trying to preserve for future generations. Silk heritage is often not accessible to citizens because of a lack of human and technological means, and even efforts to preserve this heritage digitally suffer from poor tagging, random quality and lack of accessibility.



Digitalisation efforts need to be stepped up, and the project SILKNOW (Silk heritage in the Knowledge Society: from punched cards to big data, deep learning and visual / tangible simulations) has been showing the way. "Intangible heritage such as old weaving techniques is in danger of disappearing with the imminent closure of the very few companies that still make use of these ancient machines. The struggle of the craft industry to adapt to competition is jeopardising a rich heritage that is alive and well. Thanks to the intelligent computational system we developed, we can preserve these techniques through 3D representations of fabrics at the yarn level," says Cristina Portalés, technical coordinator of SILKNOW on behalf of the University of Valencia.

SILKNOW uses pre-existent, digitised information about silk's endangered legacy, showcases it, studies it and preserves it in digital collections. Users can access the collections through an exploratory search engine, spatio-temporal maps and 3D simulations.

"We take data from the databases of several institutions, online catalogues and Application Programming Interfaces (APIs). This data is then analysed and processed with advanced text analytics and image-based deep learning techniques in order to homogenise their content, automatically retrieve semantic information, complete poorly tagged data, and translate the text into four languages," Portalés explains. "Data is mapped to a knowledge graph which can be accessed and queried through Advanced Data Analysis for Silk heritage (ADASilk). SILKNOW also represents this data in Spatio-Temporal Maps (STMaps) showing relationships between their properties. Finally, we can preserve weaving techniques with the Virtual Loom."

Something for everyone

Anyone can use SILKNOW. Say you're running a traditional textile factory and want to improve customer experience for instance. Thanks to the Virtual Loom, your customers can visualise finished designs before you even have to weave them, thereby saving time and money. You can change colours, yarns, weaves and techniques, allowing them to experiment with new designs and materials such as 3D printing and open up new markets. With ADASilk, you can even go further by accessing silk heritage to replicate or reinvent past designs and motifs.

Another interesting use case presented by Portalés is that of a Spanish language teacher wanting to use online resources.

"We specifically created La Ruta de la Seda educational materials to help teach Spanish through various aspects of silk history. The aim is to disseminate this cultural heritage and to highlight the cultural exchange sparked by its production and trade," she adds.

Other examples include tour guides tapping into ADASilk and the Virtual Loom to present the silk heritage to the public; or museums wanting to improve their catalogue using the multilingual SILKNOW thesaurus.

SILKNOW's tools are still being evaluated with the likes of students in design schools and creative industries. Future plans include a workshop with representatives of over 40 museums, work with design schools in Palermo and Lyon, and a project takeover by an intergovernmental organisation.



The struggle of the craft industry to adapt to competition is jeopardising a rich heritage that is alive and well. Thanks to the intelligent computational system we developed, we can preserve these techniques through 3D representations of fabrics at the yarn level.

PROJECT

SILKNOW – Silk heritage in the Knowledge Society: from punched cards to big data, deep learning and visual / tangible simulations

COORDINATED BY

University of Valencia in Spain

FUNDED UNDER

Horizon 2020-SOCIETY

CORDIS FACTSHEET

cordis.europa.eu/project/id/769504

PROJECT WEBSITE

silknow.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 (Big Data of the

Past for the Future of Europe) project set out to offer this by exploiting already freely accessible Big Data sources.



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.

PROJECT

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

COORDINATED BY

Swiss Federal Institute of Technology Lausanne in Switzerland

FUNDED UNDER

Horizon 2020-FET

CORDIS FACTSHEET

cordis.europa.eu/project/id/820323

PROJECT WEBSITE

timemachine.eu



Discover classical music in new ways thanks to TROMPA

Discovery of and experimentation with classical music just entered a new dimension thanks to work under the TROMPA project. Experts, musicians and enthusiasts can now benefit from digital tools facilitating their work and research.

Classical music holds a major place in our cultural heritage. It's an inexhaustible source of inspiration for musicians and scholars, it has been proven to boost our health and – the icing on the cake – it's

in the public domain for anyone to enjoy through community-built repositories. There, users can find massive numbers of scores and recordings allowing for multimodal enrichment and contextualisation.



That's for the theoretical part. In practice, repositories are still far from perfect and only specialists will find their way around them. "Repositories can be used to enrich and contextualise scores and recordings. Relevant associations across repositories and modalities can also be built, but it all has to be done manually. Insights from previous users are not explicitly stored for future users to learn from, and many of the online resources are uncured. We are really



We specifically developed pilots for music scholars, choir singers, piano players, orchestras and music enthusiasts.

missing out on the full wealth of our cultural music heritage," explains Emilia Gomez, head of the Music Information Research lab at Pompeu Fabra University.

Digital technology provides huge opportunities in this regard, and Gomez intends to put this

potential to good use thanks to funding under the TROMPA (Towards Richer Online Music Public-domain Archives) project. Her objective is clear: making classical music scores and recordings truly accessible to everyone by building up a new value chain around user involvement and reusable components.

"The typical curation/production value chain before TROMPA involved a human expert who needed to carefully curate and prepare appropriate data resources. Only then were digital music processing technologies used to process, connect and enrich these resources in depth. This production process was expensive and selective and, as a consequence, it has not yet been possible to produce enriched applications at scale."

For choir singers, TROMPA developed an application that facilitates practice between rehearsals. The tool digitally recreates the score so that singers can not only listen to their part, but also control and manipulate the rest of the musical score for audio playback. According to Gomez, this tool should notably help amateur singers to learn their part better and faster.

Piano players, on the other hand, usually need to go through other acts to improve their own and see how peers interpreted them. It's a tedious process to say the least, which TROMPA addresses with the Companion for Long-term Analyses of Rehearsal Attempts (CLARA). CLARA allows pianists to have access not only to a score they are currently working on, but also, within the same interface, to a dashboard that visually displays their performance alongside the micro-timings of other recordings.

Work for music enthusiasts focuses on the recognition of emotions induced by music, while orchestras can benefit from a tool disentangling what they depend on for their own commercial viability from what already exists in the public domain. Last but not least, a tool for scholars facilitates annotation and community sharing.

Three months before its scheduled end in April 2021, TROMPA has already achieved its main objectives. Gomez hopes that the project's tools will contribute to enriching the already vast amount of musical activities people engage in, while providing some sort of framework allowing this musical activity to be documented and shared for generations to come.

Useful apps for everyone

TROMPA fully exploits synergies between humans, data and algorithms so as to increase volumes of reusable open data matching the desired level of quality. The data benefits from improved processing mechanisms as well as more diverse, inclusive and accessible means to be discovered by five key target audiences.

"We specifically developed pilots for music scholars, choir singers, piano players, orchestras and music enthusiasts. These pilots exploit a set of reusable software components: a data infrastructure, a digital score edition tool, a library for embeddable descriptions of music data, a music performance assessment component and an annotation tool," Gomez adds.

PROJECT

TROMPA – Towards Richer Online Music Public-domain Archives

COORDINATED BY

Pompeu Fabra University in Spain

FUNDED UNDER

Horizon 2020-SOCIETY

CORDIS FACTSHEET

cordis.europa.eu/project/id/770376

PROJECT WEBSITE

trompamusic.eu



Archived data gets a second life with a new application for architects and virtual reality game designers

Architects and virtual reality game designers' work will soon get much easier and more inspired thanks to technology developed by the V4Design project. The new technology can take any existing visual content and textual information, and convert this into exploitable, semantically rich 3D models.

Our societies almost literally bathe in data. Some 2.5 quintillion bytes are produced by humans every day. In the last 2 years alone, we generated 90 % of the world's currently available data. For some of the most creative of us,

say, virtual reality (VR) game designers and architects, this amount of information is a blessing. But its heterogeneous nature calls for innovative means to reuse it by means of 3D reconstructions and models.



This is precisely what V4Design (Visual and textual content re-purposing FOR(4) architecture, Design and video virtual reality games) is about, as Stefanos Vrochidis, senior researcher at the Centre for Research and Technology Hellas (CERTH) and coordinator of the project, explains. "V4Design provides the ability to reuse and repurpose existing visual and textual content from content providers and public web resources. We integrated and combined state-of-the-art technologies in computer vision, 3D generation, text analysis and generation, as well as semantic integration and interlinking. With these, we provide architects, VR game developers and designers with innovative tools to reuse and repurpose heterogeneous multimedia content."

Imagine you're a game designer and would like to draw inspiration from archive footage and documentaries. Of course, these are great sources of inspiration, but there are currently no means to repurpose them. V4Design fills this gap by performing automatic content analysis and seamless transformation into exploitable 3D reconstructions. It's a considerable time and, by extension, money saver.

"Architects and video game designers currently use conventional analogue prototypes. These include scale models and physical demo environments such as rooms and apartments. Building such prototypes is much more expensive and time-consuming than using existing digital content. Additionally, these prototypes are static," Vrochidis points out. With V4Design, producing prototypes is faster, cheaper and more efficient, and allows for easy modifications on top of 3D dynamic models.

A world of opportunities

V4Design encompasses two authoring tools: One for VR game designers and one for architects. Both apply innovative 3D model reconstruction techniques to the visual content (videos and images) in order to extract 3D assets of interest like buildings and objects. From there, computer vision and text analysis solutions process the content, extract annotations and dynamically enrich the generated 3D models with information. By the end of the workflow, all available information is semantically interlinked in rich knowledge graphs, offering advanced indexing and retrieval capabilities. Meanwhile, text generation is used to create multilingual summaries of the assets and assist end users in using the information.

The V4Design project is due to be completed in March 2021, however the two solutions are already operational. The one for architects is presented as a plugin built on top of the well-established Rhinoceros 3D application, while the second one for game designers can be launched either through the Unity game engine or directly via the VR environment.

Architects can use the application for architectural design related to existing or historical buildings and sites. Meanwhile, VR game designers can, for instance, create a time-travel VR experience. But Georgios Meditskos, postdoctoral research associate at ITI-CERTH and also the technical manager of the project, doesn't exclude other potential applications. "Examples include first response in a disaster event, where the creation of a 3D, semantically enriched environment could increase the situational awareness of every person involved and improve decision-making," he outlines. "In healthcare, we could create digital twins of patients and integrate them inside a VR environment for high-value monitoring and treatment solutions. We could also think of automotive design and cultural heritage."

The project is now in its final phase and the team are busy preparing the final version of the platform. This work includes rigorous testing and resolving of any emerging issues to guarantee the high quality and reliability of the platform. "With the last stages of the project now in full swing, we are organising the final evaluation phase to validate and assess the solution in real world architecture and VR game design use cases," Meditskos concludes.



Architects and video game designers currently use conventional analogue prototypes. These include scale models and physical demo environments such as rooms and apartments. Building such prototypes is much more expensive and time-consuming than using existing digital content.

PROJECT

V4Design – Visual and textual content re-purposing FOR(4) architecture, Design and video virtual reality games

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DATA PROTECTION: NEW TECHNOLOGIES TO PROTECT PRIVACY

In the wake of the General Data Protection Regulation (GDPR), this issue of Research*eu introduces seven EU-funded projects that have been working on innovative tools and solutions to help ensure the protection of data and individual privacy.



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