

# The International Project VirtualArch: Visualization and Presentation of Hidden Archaeological Heritage Across Central Europe

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Different approaches and challenges, sharing experiences but reaching the same goal – a better understanding and raised awareness of hidden archaeological heritage and its protection by presenting it via new information and communication technologies like VR/AR. That is the main background of the EU-project “VirtualArch – Visualize to Valorize”, running from July 2017 to June 2020. Ten partners from eight central European countries try to elaborate a transnational strategy to valorize hidden archaeological monuments by visualizing them. Therefore, eight selected pilot sites were digitized/visualized and presented to stakeholders via guided field tours and information points on spot. The pilot sites are presenting different archaeological types, forms and periods like prehistoric and medieval mines, roman and medieval harbors as well as cultural landscapes with prehistoric pile dwellings or urban archaeology with huge and complex stratigraphy. This includes also different areas and environments, impacts and audiences. Although the project is still in its first half, the session seems to be a perfect area to present project and its actors as well as share first experiences with all present professionals and experts.

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## Key words:

Heritage communication and protection, VR/AR, transnational cooperation approach.

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## INTRODUCTION

The rich and diverse archaeological heritage of central Europe is in parts excellently developed and utilized. But in contrast to finds in museums, a broad share of this heritage sites, even of international importance, is very often hardly visible and tangible for the public. Moreover, archaeological heritage is affected by different human activities and spatial usage conflicts.

VirtualArch focuses on the practical application of innovative and trendsetting visualization tools in the field of virtual and augmented reality [Reffat and Notfal 2013]. One of the aims is to unveil regional archaeological heritage – located underground or submerged, partly with global importance (UNESCO) – to local and regional stakeholders that are responsible for economic development. By tailoring and implementing of target group oriented and specially designed visualizations and presentations using “Virtual or Augmented Reality” (VR/AR), their level of awareness and acknowledgement will be increased [Frontoni et. al. 2015]. Furthermore, virtual reconstructions could be used as innovative visualization tool during spatial usage conflict management and hence contributes to a better heritage protection.

VR/AR provides not only a better accessibility to hidden or inaccessible archaeological heritage, but offers also new possibilities for tourism, regional development, cultural participation and the usage of archaeological data in the field of creative industries and media sector. Even virtual open-air-museums could be built [Unger et. al. 2016].

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## PARTNERS AND PILOT SITES

Different to many other VR/AR visualization projects in archaeology, VirtualArch approaches through transnational cooperation with different heritage. Facing similar challenges and sharing same objectives, ten partners from eight countries get together in a EU-funded project (Interreg Central Europe), running from 2017 to 2020. The partner consortium is composed of regional and national archaeological institutes and heritage offices, two universities/research institutions and also two local communities as heritage owner. On eight selected pilot sites all over Central Europe, their experiences were shared, distinct innovative visualization and communication approaches were discussed and introduced, special applications due to the demands of each heritage and their audience developed [Lobinger and Hemker 2018].



Fig. 1. Pilot sites and partners of Interreg Central Europe project “VirtualArch – Visualize to Valorize”  
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This heterogeneous approach is also reflected in the diversity of the pilot heritages, like in Fig. 1. The sites are characterized by various archaeological cultures, areas, environments, impacts and challenges. All of these sites contains unique finds, often from organic material like Fig. 2 which allows a huge insight of past life and procedures and thus of international importance for research and general public. But none of them are accessible or even visible, and because of their complex structures they are also hardly tangible especially for non-professionals.

According to their nature the pilot heritages can be separated in three groups: urban area, mines and underwater sites. Each of these groups has its specifics, as in a way of the gathering primary data, but also in a way in which

they are further presented to a public. Also, each pilot site has its specifications concerning the main aim of what is there to be achieved as a goal.



*Fig. 2. Wooden parts of a winch in a medieval mine under the current town of Dippoldiswalde  
(© Archaeological Heritage Office of Saxony; photo by Martin Jehnichen)*

Within the group of mining heritages there are at first the prehistoric salt mines of Hallstatt (Austria), since 1997 part of the UNESCO cultural landscape “Hallstatt-Dachstein/Salzkammergut”<sup>1</sup>. Known in the scientific community for the famous cemetery excavated in the 19th century, Hallstatt is one of the most important sites in European archaeology, thanks to outstanding results of excavations and experimental researches undertaken by the Natural History Museum Vienna since the 1960s in the still active salt mines [Reschreiter et al. 2018]. Nowadays, the Salt Valley is already a popular tourist destination with a good infrastructure, so the aim in this project is to develop more precise and attractive ways of presenting the finds or to show them in a new light for the public. On the other hand, the heritage is threatened seriously by natural movements of the rock itself [Reschreiter et al. 2017].

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<sup>1</sup> <https://dachstein.salzkammergut.at/en/world-heritage-hallstatt-dachstein-salzkammergut.html>



*Fig. 3. Survey and digitization of prehistoric mines in Hallstatt (© Natural History Museum, Vienna)*

The second important mining heritage is located in Saxony (Germany), where unique and almost complete mines of the Middle Ages were found under the Town of Dippoldiswalde. As part of the “Erzgebirge/Krušnohoří mining region” (Ore Mountains), the Dippoldiswalde medieval silver mines recently achieved UNESCO World Heritage status<sup>2</sup>. Since 2008, the Archaeological Heritage Office of Saxony records and recovers this outstanding heritage [Hemker 2011; Hemker and Schubert 2018], which is – due to security reasons – not accessible and visible for non-professionals or tourists.

Another big mining landscape was in the mountainous area around Civezzano (Italy) near Trento. Especially from the 12th to the 15th century silver ore was exploited there intensively so archaeologists discovered a mining area with sinkholes and gallery entrances over 12 km<sup>2</sup> [Casagrande 2013]. Due to security reasons they are not accessible and threatened itself by agriculture and forestry.

A big and important mining and metallurgic settlement from the 13/14th century next to visible mining relicts was discovered near Utín in the Bohemian-Moravian highlands [Derner et al. 2016]. The settlement, mostly known thanks to geophysical surveys, includes interesting features like miners' houses, ore mill, a stamping mill or furnaces as well as a hospice and a filial chapel. The area is nowadays rarely inhabited but agriculture and especially forest activities could endanger this interesting site. Identifying in its full extend, virtual reconstructions and target group oriented lectures and tools enables a better understanding and consequently protection, for example by creating special exclusion zones.

Urban archaeology is represented by the pilot site Nitra (Slovakia) which was a princely residence since the 9th century and is of national importance as oldest center of early Christianity [Fusek and Bednár 2008]. The urban area of Nitra was settled since the Neolithic period. The settlement layers and layers of rebuilding made the archaeological localities invisible to the visitors' eyes. Here, mainly the excavations done since 30 years by the Slovak Academy of Sciences as well as small finds will be visualized to present the importance of the site from the smallest detail like a tiny cup to the big picture [Ruttkay 2011].

<sup>2</sup> <https://www.montanregion-erzgebirge.de/en.html>

In contrast to the latter example, the Slovenian pilot region<sup>3</sup> is a large wetland area near Ljubljana containing several prehistoric pile dwellings, since 2011 UNESCO World Heritage.

.The pile dwellings are a tremendous source of information not only for archaeology, but also for dendrochronology, botanic, climatology, geology and other fields of interest. The preservation of this archaeological heritage of a global importance is however heavily endangered. Ljubljansko barje constitutes a very attractive area from agricultural land-use point of view and is therefore highly endangered by the interventions of the local farmers e.g. building new, deep drainage channels and deep ploughing. Interactive landscape history visualizations and AR applications showing the nowadays invisible settlement structures should sensitise the stakeholders for a better protection.

Finally, the special field of underwater archaeology is represented by two important harbors: First, we have the ancient roman harbor Barbir in Sukosan, located at the Adriatic Sea coast of Croatia. There are several submerged stone structures as remnants of piers or breakwaters as well as pottery and small finds from the 3rd to 4th century. Although the International Centre for Underwater Archaeology is seated in near Zadar, only few research and surveys were conducted and the site is almost unknown to the public. Second, a large site from the 10th to 14th centuries in the Baltic Sea is known offshore of the Polish town of Puck [Pomina et al. 2016]. Over an area of 12 acres several remains of the harbor construction, 4 shipwrecks, potsherds and bones from the 10th to the 14th century were found. Puck was probably the largest early medieval port in the southern Baltic Coast, bigger than well-known places like Haithabu, Schleswig or Lübeck.

## FROM 3D SURVEYING TO VIRTUAL MODELS

Although the differences between the heritage sites, the activities in the pilot regions are based on a same multi-stepped strategy:

First, all partners were gathering and digitize data of the archaeological pilot heritages like in Fig. 3, including field surveys and aerial reconnaissance. Finds and archaeological features were 3D recorded via different techniques ranging from structure-light scanners to photogrammetry and 3D scanning of finds<sup>4</sup> as well as hydroacoustic survey methods for the underwater sites.

The obtained and processed data provides the base for modelling of the virtual reconstructions as the second step. Depending on the visualization options and the “storytelling” behind it, the high resolution meshes have to be reduced, missing items added or situations and textures exchanged, like Fig. 4.

In the third step the result – the almost realistic virtual model of a heritage – will be visualized via various VR/AR options. During the year 2018, project partners met together as well as with other interested parties (external experts, stakeholders etc.) to create a coherent vision for digitalization and visualization of the pilot sites. This contains interactive panorama views of e. g. prehistoric or medieval settlements which are now invisible under the current construction of modern town or under the surface of farmland like in Fig. 5. Interactive 3D models of small finds or even whole landscapes allow a better understanding of the subject. With AR methods, users could walk virtually through past settlements and mines directly on resp. over the heritage site. Finally, new VR data glasses enables immersive experience of inaccessible sites using “ancient items” which are normally hidden in archives or exhibited in showcases of archaeological museums.

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<sup>3</sup> <https://www.palafittes.org>

<sup>4</sup> For the mining archaeology see for example [Göttlich and Reuter 2013]



*Fig. 4. Virtual reconstruction of a medieval mine based on archaeological surveys and digital documentation methods (©Archaeological Heritage Office of Saxony; image by Jiří Unger)*

## VIRTUALARCH MOBILE APPLICATION FRAMEWORK

To understand the heritage, its background and to discover several “points of interests” in hardly visible heritage landscape, these special applications were provided through a developed transnational mobile app with information texts, pictures, videos and interactive maps about the heritage.

Programming an app is expensive; keeping the content up-to-date furthermore requires regular updates which add up to the running costs. Furthermore, the diversity of the pilot monuments and local realization concepts make “one App” almost impossible. In our work for the EU Project VirtualArch, we have thus sought a way in which each partner can cross certain technical barriers and produce a location-based App without need for programming or external consultancy.

Therefore, we have produced a portal which allows for each pilot site the upload of a zip file containing a range of media (images, text, 3D files, panoramas, movies) in one or more folders; each one is transformed into a point of interest on a map for which the associated media can be shown as a slideshow. The key strength of the approach lies in the fact that the portal can produce both web presentations as well as apps using the same content. Technically this is achieved via the use of rules for transforming the content into html/css + javascript, and Apache Cordova/Adobe PhoneGap for turning the resulting web page into an app. Concerning individual wishes links to supplementing applications with VR/AR content are possible. With this portal and immersive visualizations tools partners now have the possibility to disseminate their often complex research, archaeological relevance of their heritage and detailed protection objectives frequently to a wider public using only smartphones.



*Fig. 5. Making visible the invisible via VR/AR mobile applications (© Archaeological Heritage Office of Saxony)*

## IMPLEMENTATION, COMMUNICATION AND ENHANCING CAPACITIES

Archaeological stakeholders of the partner territories will be involved in the planning and implementation of the pilots and the evaluation of their success. Workshops and guided field trips are offered to them to learn more about the existing heritage and raising their awareness, especially in case of heritage threats and protection conflicts. Beside, workshops and conferences about related topics – archaeology & tourism, public archaeology, archaeology & agriculture or usage of archaeological data in media sector – bolster the knowledge of all partners and capitalize good practises (for upcoming events, see <https://www.interreg-central.eu/VirtualArch>).

For a better physical appearance and access, especially other audiences like tourists or local communities, the partners realize further smaller investments such as information boards with basic heritage information or WiFi hotspots providing internet access for free app downloading on their own devices. QR codes links to digital data, markers open 3D model in the various AR applications. Beside conventional communication methods, users could experience archaeology on a complete new way. Due to this valorization of heritage, both regional identity and cultural participation could be enhanced boosting also local tourism and regional development.

But not only non-professional locals and tourists should learn about their “heritage”, also future generations like students, young researchers and specialists from the fields of archaeology and related subjects have the opportunity to be involved and increase their knowledge in virtual archaeology and their methods in an upcoming (and free of charge) summer school in June 2019, organized by Partners in Torun (Poland).

Based on the experiences in these pilot regions a transnational strategy for future projects as well as guidelines for similar heritage sites will be worked out. In addition, the development of a free accessible visualization home kit is planned providing existing 3D models including detailed information about find spot, age determination, chronological and regional occurrence as well as the important question about accuracy of virtual reconstruction. Users, especially small actors like local museums, could utilize these models as base for their own small-budget visualisation projects (building-block principle) following the strategies of VirtualArch.

Archaeological heritage and the sharing of knowledge about them is a public matter carried out by different regional and national archaeological institutions. VirtualArch enhance this duty by introducing and promoting VR/AR approaches as possible new path in communication and protection of our cultural heritage.

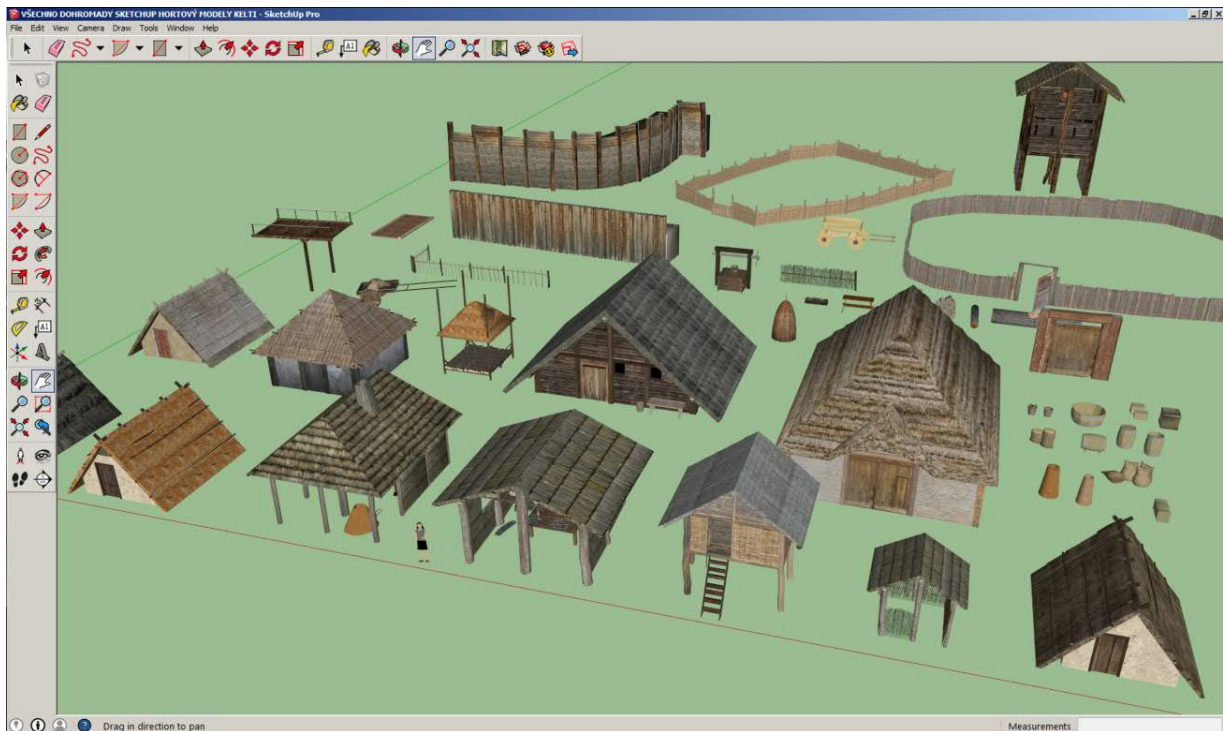


Fig. 6. Different components for a virtual reconstruction of an early medieval settlement, based on modular principles (© Institute of Archaeology of the CAS, Prague)

## CONCLUSION

One of the important contributions of the VirtualArch project is the implementation of cultural mediation, as one of the central tasks of archaeological heritage. By using modern IT technologies hidden or inaccessible archaeological sites and areas such as mines, harbors and settlements become virtually accessible to various interest groups. Even complex facts and reconstructions were presented understandably by the applied VR and AR technologies directly on site. Beside this, coming from eight European countries and different institutions dealing with archaeological heritage matters, all project partners create a broad base of experience and promote the international exchange of scientific, strategic, legal and methodical information. As a result of the cultural mediation, the public awareness for these "nonvisible" archaeological places will increase; the heritage offices will be able to reconstruct sites i.e. for stakeholder meetings (conflict management). At the end of the project the applied VR and AR technologies explained by the guidelines will be open not only for heritage or archaeological institutions but as well for tourism offices or local museums to promote and protect their archaeological heritage in their region.

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