

June 2018  
Volume 1, Issue 3

# 3rd iMARECULTURE Newsletter

## EDITORIAL

Dear reader,

We are pleased to welcome you to the third issue of the iMARECULTURE newsletter. We are mid-way to project's duration, which started on 1st November 2016, iMARECULTURE is a three-year EU project, funded by the European Commission under the H2020 research and innovation program under grant agreement No 727153.

The previous six-month period was devoted in application development and pilot tests. After gathering almost all necessary information and data, pilot applications of VR immersive visits to submerged cultural heritage and initial evaluation helps establishing common grounds among our interdisciplinary group and cooperate to improve and build upon the initial concept. Two serious games are at their final stage. Underwaters tests for the AR applications were conducted in Baiae in June, gathering many data and comments for improvements. The publicity of the project increases with interviews from [national](#) and international TV. Also, the Euronews TV, visited our expedition and filmed our divers testing the underwater hybrid positioning system, using tablets and smartphones. Storytelling, which will highlight the educational aspect of our applications, is progressing. The web site is under complete redesign and reformation, to facilitate the downloading of forthcoming data and applications. Publications and upcoming events are also reported. Enjoy and don't forget to follow us in social media!

  
Dimitrios Skarlatos

iMARECULTURE Project Coordinator

On behalf of the iMARECULTURE Consortium

OUR HERITAGE:  
WHERE THE PAST  
MEETS THE FUTURE

2018   
EUROPEAN YEAR  
OF CULTURAL  
HERITAGE  
#EuropeForCulture



iMARE Culture

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

[www.imareculture.eu](http://www.imareculture.eu)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727153

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## FIRST PILOT TEST OF THE UNDERWATER AR TABLET IN BAIAE, ITALY

Last month, the consortium tested the AR technologies developed in the project at the Underwater Archeological Park of Baiae. Thanks to the precious collaboration with the Archaeological Park of the Phlegraean Fields and under the coordination of the activities on the field



*Testing the acoustic tablet over the mosaic of the villa con ingresso a protiro*

by MIBAC-ISCR, it was possible to test the systems and technologies developed by 3DR and MU for the underwater visit in augmented reality, inside the Villa con ingresso a protiro. In particular, 3DR tested for the first time in the submerged site of Baiae, an innovative underwater location system that allows divers to view, through a tablet housed in a waterproof case, their



*Testing the target based AR over the mosaic of the villa con ingresso a Protiro*

position on the map of the archaeological site, to receive information contextualized in relation to its position and, above all, to enjoy a spectacular 3D reconstruction that shows the visitor how the villa could appear in its heyday. Additionally, MU tested in collaboration with CUT, a tablet and an android phone housed in a waterproof case that allows the user to enjoy a virtual 3D reconstruction of the villa. Moreover, through the tested applications, the user is able to dehaze the un-



*Placing the necessary targets for the AR application*

derwater scene in real time and enjoy the real colour of the underwater scene. These second tests were based only in visual information and QR code target placed on the seabed. Even with these very poor visibility conditions, results are extremely encouraging and during the tests, important data were collected regarding the navigation system functioning, the QR codes detection and tracking and the underwater dehazing performance, which will be further refined and optimized during the next months. Augmented reality applied to the submerged environment represents an absolute novelty in the field of underwater technologies. This technology, in fact, will allow visitors of the Submerged Archaeological Park to fully enjoy the dive and appreciate the richness and extent of the ancient Roman villas of Baiae, now submerged due to the bradyseism phenomenon.

### *The European Year of Cultural Heritage 2018*

*"Throughout 2018, we will celebrate our diverse cultural heritage across Europe - at EU, national, regional and local level. The aim of the European Year of Cultural Heritage is to encourage more people to discover and engage with Europe's cultural heritage, and to reinforce a sense of belonging to a common European space. The slogan for the year is: Our heritage: where the past meets the future". For more info follow the [link](#).*

**2018**   
**EUROPEAN YEAR  
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## DRY VISITS DEMONSTRATION IN BAIÆ MUSEUM



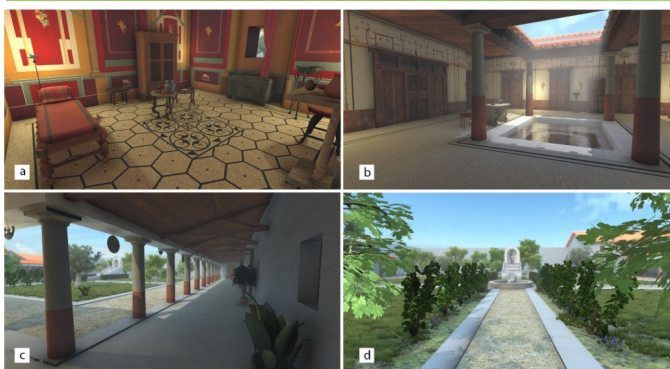
*Dry visits demonstration and shooting for Euronews*

Together with the underwater AR pilot, immersive virtual reality applications were tested too within the wonderful setting of the Aragonese Castle, where the Archaeological Museum of the Phlegrean Fields is located. Through a headmount display, these apps allow those who do not dive to virtually visit the Mazotos shipwreck site and the Villa with the Protiro entrance. In the case of the Villa, scenes are revealing the daily life, rebuilt in the context of the project, according to the story-telling approach. All the tests carried out in these days, as part of the iMARECULTURE project, have been documented by a troupe of the Euronews station, who also interviewed the partners during the activities at sea and at the Aragonese Castle of Baiae. Stay tuned on [Euronews](#) for the release of the video during the week 17-23 of September.

## VILLA CON INGRESSO A PROTIRO VIRTUAL RECONSTRUCTION

The virtual reconstruction of the complex of the “Villa con ingresso a protiro” dated to the first half of the II century AD, Hadrian Emperor era, located in the Marine Protected Area - Underwater Park of Baiae (Naples) performed in order to facilitate the VR visit on it.

The applied virtual reconstruction method exploits the high-resolution data acquired by using the latest techniques for the construction of acoustic microbathymetric maps together with drawings and other historical and archaeological information to build a suggestive 3D digital reconstruction of underwater architectures not anymore existing. It is based on an iterative feedback that allows for reaching the best reconstruction results, helping the archaeologists to better focus their reasoning through a detailed visual representation, and the technical experts to avoid misleading details in the final virtual model. This workflow involves several professional figures, such as 3D graphic designers, archaeologists, and art historians. In order to build the architectural model, we have added on the conceptual model structure details like roofs, columns, doors and windows, referring to the images and documents collected during the data acquisition task, and taking as an example the Roman villas dated at the Second Century AD. The archaeological reconstruction of the roof covering, of the wall paintings and of the furnishings as of the garden, are purely hypothetical because no traces of these ar-



*The exterior (up) and interior (down) of the virtual reconstructed Villa con ingresso a protiro in Baiae, Italy*

chaeological data have been documented underwater. In fact, the remains of the walls of the Villa are almost completely disappeared. For example, the room paved with the mosaic floor n. 19 has the perimeter walls measuring about 5-10 cm high, along the seaward sides to the south and the east while the walls in the northern and western side measure about 50 cm in height. For more information see the related [article](#).





## THE COLLABORATIVE VR UNDERWATER EXCAVATION GAME

Underwater excavation is still a very difficult and demanding task. One of the main problems is how to train inexperienced archaeologists. One of archaeology's most challenging tasks is known as dredging. Within the IMARECULTURE project a novel system for simulating

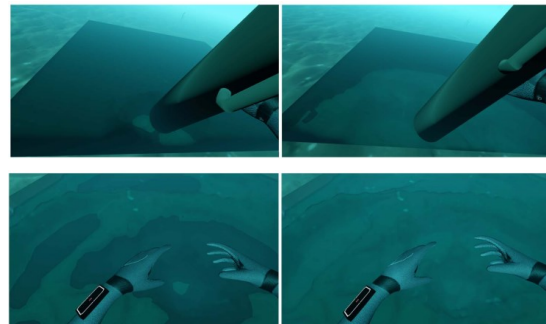


Testing the underwater excavation game

underwater excavation techniques using collaborative immersive VR has been developed. The focus is not on simulating swimming but on excavating underwater while following established archaeological methods

and techniques. In particular, the use of dredging procedures was implemented by a realistic simulation of sand in real-time performance. The working area for performing dredging with an airlift is currently limited to 2 by 2 meters, and users need to excavate it aiming to find artifacts within a specific amount of time.

For more information on this topic read the related [article](#) and watch the video on [YouTube](#)

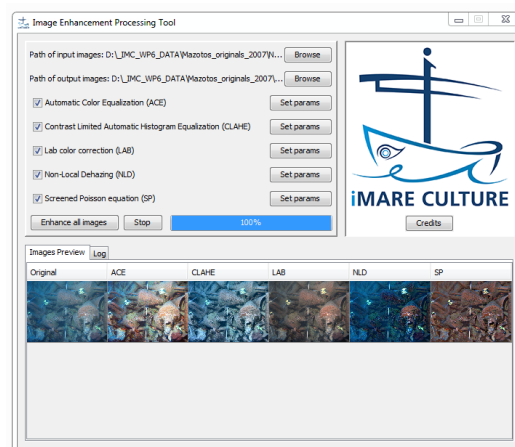


Users work with the dredging device (airlift) to remove a layer of sand (up). The colorization of the layers is optional and can be turned (down left) on or (down right) off by the users, helping the users to perform the excavation stratigraphically

## IMAGE ENHANCEMENT PROCESSING TOOL

A software useful to automatically process an underwater images dataset with a set of image enhancement algorithms was developed in the context of the project and was employed to simplify the evaluation of the image enhancement algorithms. This software implements five algorithms that perform well and employ different approaches for the resolution of the underwater image enhancement problem, such as image dehazing, non-uniform illumination correction and colour correction. The decision to select certain algorithms among all the other is

based on a preliminary brief evaluation of their enhancement performance. There are a lot of methods for underwater image enhancement and we considered the vast majority of them. However, for this implementation we selected the algorithms for which we could find a trustworthy implementation done by the authors of the papers or by a reliable author. Within these algorithms, we conducted our preliminary evaluation, in order to select the ones



The GUI of the Image enhancement processing tool

that seemed to perform better in different underwater conditions. You can download the tool [here](#).



## STORYTELLING

Storytelling for iMARECULTURE aims to enhance the edutainment quality of developed applications. UoS has created cutscene stories for Seafaring game in collaboration with the team of archaeologists from UCY. These stories introduce the players with Navigation techniques, Banks and banking system, Pirates, Slave trade, Commodities, Sailing seasons, Ships, Life on board,



*Green screen filming for Baia storytelling*

Trade and smuggling and Coins and currencies. They are created as combinations of hand drawn backgrounds containing some objects symbolizing the historical period in question (temples, ships, squares, interiors with some typical furniture, seaside, harbours

etc.) and a superimposed actor-narrator in typical



*Seafaring game cutscene story about pirates*

outfits performing 11 different roles.

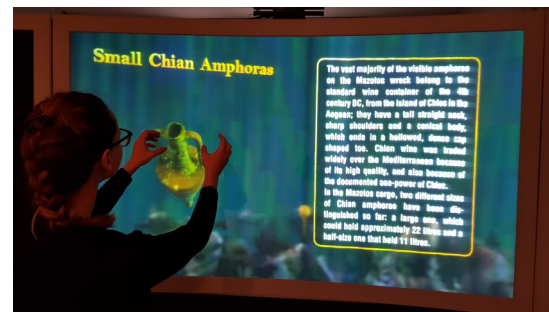
Storytelling for Baiae dry visit application introduces a new challenge of 360 video, where the rules of film directing do not apply any more. The VR stories, created in collaboration with partners from 3DR and MI-BACT, will recreate a plot happening in the Villa con ingresso a protiro. The actors recorded against the green screen background will be superimposed into the Villa's 3D reconstruction and corresponding 3D drawings. They will inhabit the 3D model of the Villa and wait to be activated by the users.

## 3D VISUALIZATION FOR LIGHT FIELD 3D DISPLAY

HOL have created a 3D visualization of the underwater scene reconstruction for their light field 3D display. This



and provides additional information for various points of interests. After developing the initial application



*Visualization of complex 3D scenes and interaction with the 3D objects*

technology enables users to enjoy the presented scenarios interactively without wearing any cumbersome equipment. The dry visit application developed for the consortium is capable of visualizing complex 3D scenes

framework, HOL is currently in the process of testing and optimizing the rendering for the final underwater scenes created for the project.





The project i-MareCulture is unique, innovative and promising, contributing fully to the H2020 Framework and the Digital Agenda for Europe, a H2020 initiative, for New Skills and Jobs. In addition, this project abides by the EU's strategy to become a smart, sustainable and inclusive economy by implementing the knowledge triangle by connecting the Education, Research and Industry by supporting and boosting innovative enterprise to develop their technological breakthroughs into viable products in the area of Virtual Museums and Digital Heritage, with real commercial potential.

## PUBLICATIONS IN RELATED EVENTS, CONFERENCES AND JOURNAL ARTICLES

Petriaggi Davide, B., Petriaggi, R., Bruno, F., Lagudi, A., Peluso, R., & Passaro, S. (2018, June). A digital reconstruction of the sunken "Villa con ingresso a protiro" in the underwater archaeological site of Baiae. In *IOP Conference Series: Materials Science and Engineering* (Vol. 364, No. 1, p. 012013). IOP Publishing.

Agrafiotis, P., Skarlatos, D., Forbes, T., Poullis, C., Skamantzari, M., & Georgopoulos, A. (2018). UNDERWATER PHOTOGRAMMETRY IN VERY SHALLOW WATERS: MAIN CHALLENGES AND CAUSTICS EFFECT REMOVAL. *International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences*, 42(2).

Ben Ellefi, M., Papini, O., Merad, D., Boi, J. M., Royer, J. P., Pasquet, J., ... & Drap, P. (2018, April). Cultural heritage resources profiling: Ontology-based approach. In *Companion of the The Web Conference 2018 on The Web Conference 2018* (pp. 1489-1496). International World Wide Web Conferences Steering Committee.

Agrafiotis, P., Drakonakis, G. I., Skarlatos, D., & Georgopoulos, A. (2018). Underwater Image Enhancement before Three-Dimensional (3D) Reconstruction and Orthoimage Production Steps: Is It Worth?. MDPI.

Kouřil, P., & Liarokapis, F. (2018). Simulation of Underwater Excavation Using Dredging Procedures. *IEEE computer graphics and applications*, 38(2), 103-111.

Mangeruga, M., Cozza, M., & Bruno, F. (2018). Evaluation of Underwater Image Enhancement Algorithms under Different Environmental Conditions. *Journal of Marine Science and Engineering*, 6(1), 10.

## UPCOMING EVENTS

**September-October 2018: 2nd Pilot tests of the AR application of the project**

**November 2018: 24M meeting of the project in Rome, Italy**

**2-3 May 2019: 2nd International Workshop "UNDERWATER 3D RECORDING & MODELLING - A tool for modern applications and CH recording" in Limassol, Cyprus. For more information visit [here](#)**

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