An Innovative Use of Gaming Technology for the Presentation of Stratigraphic Information: A Presentation of the Palaeolithic Deposits at Scladina Cave *(Belgium)*

Grégory Abrams[1], Kévin Di Modica[1], Dimitrios Ververidis[2], Phil Cheeseman[3], Frédéric Bezombes[3], Dominique Bonjean[1], Alex Hardy[4], Spiros Nikolopoulos[2], Frédéric Precioso[5], Andy Shaw[3], Christoph Strecha[6], Isabelle De Groote[3]

1 - Scladina Cave Archaeological Centre · 2 - CERTH · 3 - Liverpool John Moores University · 4 - Vulcan UAV · 5 - Université Nice Sophia Antipolis · 6 - Pix4D

Abstract

The Horizon 2020-funded DigiArt project is currently in its final year. The main aim of the project is to improve the process of mass 3D digitisation for the cultural heritage sector. This objective includes the creation of a range of software solutions and commercially low-cost hardware to make the process of virtual curation and virtual visits for the public more democratic and user friendly. These tools are meant to author dynamic scenarios into 3D cultural worlds. Although the definition of visitor in this project is considered the general public, there is a real scientific potential beyond this stakeholder.

The Story Telling Engine software package that is being created as part of this project can easily be adopted for providing more informative and more immersive ways of disseminating site information to the scientific community. The ease of a drag and drop feature to add 3D models of whole archaeological sites or specific stratigraphic profiles and associated objects makes for a user-friendly tool.

As a demonstration of DigiArt's Story Telling Engine and its usefulness in academic dissemination, we present a stratigraphic profile of Scladina Cave *(Belgium)*. This new user-friendly tool allows for all stratigraphic records to be easily integrated into a high detailed 3D model of the cave and allows archaeologists to follow the evolution of the excavation and to reposition all the discoveries in situ.

Presentation of the DigiArt project

DigiArt is a Europe-wide project aimed at providing a new, cost efficient solution to the capture, processing and display of cultural artefacts.

This project is unique in its collaborative approach: cultural heritage professionals working directly with electrical, mechanical, optical and software engineers to develop a solution to current issues faced by the museum sector.

The aim at the end of the project is to allow the public to visit sites and their collections using augmented reality (in situ) and virtual reality *(off-site)*. In the VR experience, the visitor will walk through a completely reconstructed 3D model of the site and interact with the artefacts. This would not be possible without this technology.

Although the process of creating these immersive virtual experiences sounds complicated, the aim is to develop simple tools for neophytes, such as the Story Telling Engine (STE) presented here.

Scladina Cave v3.0

Scladina Cave (Sclayn, Belgium) is a cylindrical karstic cavity that extends more than 39m into the limestone bedrock *(Fig. 1)*. The cave has been under scientific excavation since 1978 and is the site of a permanent interdisciplinary research program. Shortly after excavations began, two main Middle Palaeolithic archaeological complexes were identified as well as the remains of a Neandertal child unearthed since 1990.

In 2015 and 2017, the three main caves (Scladina, Saint-Paul and Sous-Saint-Paul) composing the network of Scladina as well as the immediate outside surroundings were digitised using 3D scanning (LiDAR) and photogrammetry techniques.

The LiDAR resulted in a high-precision (<1cm) topographic model of the ~90m long cave system *(Fig. 1)*. The photogrammetry is based on more than 6000 HD images *(Fig. 2)*. Combined, both acquisition techniques should offer a 3D textured model of the cave system with a precision that has never existed before.
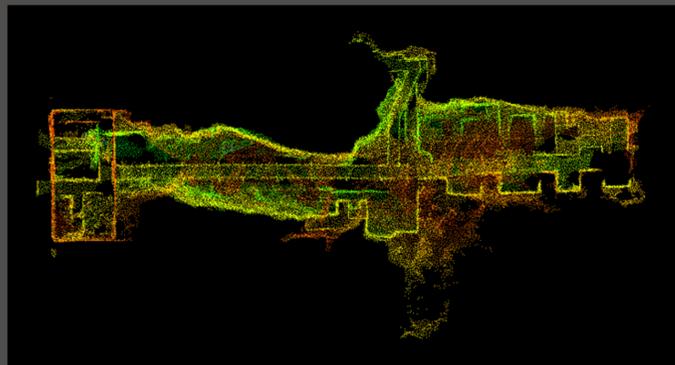

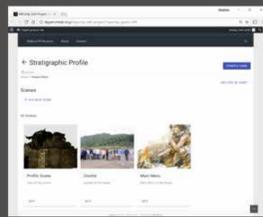Fig. 1: Zenithal LiDAR view of Scladina Cave.

Fig. 3: Story Telling Interface based on WordPress.

Fig. 4: Possibility in the STE of managing and modifying the properties of the object (e.g., the texture).
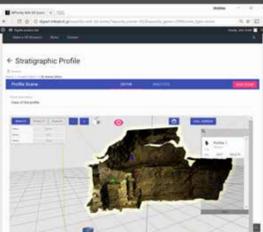

Fig. 6: First person view of the stratigraphic profile in the 3D editor.

Fig. 2: Digitisation of a stratigraphic profile using photogrammetry.

Fig. 5: View of the stratigraphic profile in the 3D editor.

Fig. 7: 3D editor allows the user to rescale the model and to modify the orientation of the 3D model.

The Story Telling Engine

The design of the Story Telling Engine (STE), as part of DigiArt is aimed at creating virtual reality visitor experiences. We propose to use the STE for easy scientific dissemination of 3D data.

The STE is based on WordPress (website CMS) and Unity (game development engine), which combines the simplicity of development and an ergonomic interface. The tool facilitates the creation of site scenes where 3D site models can be combined with object models and rescaled in a few easy steps.

It is also possible to add information levels and highlights. The models entered into the STE will then be automatically converted into an immersive visit using UNITY, and will be supported by Oculus Rift VR headsets.

This way of displaying the site will then allow scientists to be fully immersed in the site and its objects. The games can potentially be uploaded as appendices to publications.

Even though the project is still ongoing, our evaluations of the software have revealed a number of restrictions: the accuracy of the 3D model uploaded in the STE will depend on the quality of the model created in other software (photogrammetry) or directly obtained using 3D scanners.

The user-friendly interface of the Story Telling Engine will allow all users to implement video games without in-depth knowledge of programming and allow archaeologists to manage a GIS without the need of being computer engineers.