the visitor can access 3D-captured content of National and Local Heroes in order to compete against them in a 3D environment. Then, this 3D interaction is enhanced by legacy videos and content about the TSGs, their history, instruments and modalities. Different stories are authored by museum curators, put in context and published in order to share and engage the visitors of the museum.

★ How do these technologies differ from similar market offerings?

As far as we know, until now there has been no market offering other than video that digitally captures skills in 3D or records the unique movement signatures of players. Mainstream sports like football, American football and basketball use very precise motion capture and analysis technologies owned by large companies like Vicon, but the cost of such an approach is very high. On the contrary, REPLAY is looking towards a low-cost capturing, processing and analysis platform based on off-the-shelf technologies combining Microsoft Kinect devices with WIMUs.

★ You can recover 3D motions even from historical films. How did you make that possible?

The main skills of 'National Heroes' can be recovered from TSG video legacy recorded with non-calibrated monocular cameras. This reconstruction generates an animated skeleton which represents the movements and poses of the player, along with the trajectory of the ball, all in a 3D environment. Such data can then be used in virtual museums, immersive virtual systems or video games.

To achieve this, a semi-automatic approach has been implemented in which a set of 2D representations of the scene's elements (camera, ball and player) are manually marked in key frames of the video. Then, an automatic process estimates the calibration parameters of the camera, the 3D positions, poses and body part dimensions of the players, as well as the trajectory of the ball. In-between frames are automatically calculated taking into account constraints related to human kinematics and collisions with the environment.

★ What types of markets and businesses are you targeting with this project?

Intangible Cultural Heritage is the natural market for the results of the project. One potential example of application is the preservation of handcrafters' skills by capturing and recognising the gestures performed by some parts of the body (hands, arms and feet) using low-cost standard equipment.

Another potential scenario is rehabilitation, as determining whether the movements of the player are complete and correct can become a big problem. Multiple motion capture modalities should be evaluated and combined, including the already ubiquitous monocular Webcams, depth sensing devices such as Microsoft Kinect and emerging wireless low-cost sensors (mainly inertial sensors). The combination of one or more sensing devices will lead to different uses for the platform (i.e. the use of a low-cost Webcam to practice at home; a Microsoft Kinect device for motion capturing; and multiple Kinects and/or wearable sensors for large-scale installations at nursing homes or even hospitals).

★ The project ends in February. What are your plans until then and after it finishes?

In January 2016 the final REPLAY platform will be tested by real users both in the Basque Country and in Ireland. The PLAY&LEARN scenario will be evaluated with children (aged 8 to 16) from Pelota schools from the three Basque provinces and the south of France. For the Gaelic Sports, the three scenarios will be validated: the PLAY&LEARN scenario with children from primary schools in the Dublin area; the COACH&TRAIN scenario with coaches from several Irish clubs and their players; and the INTERACT&PRESERVE scenario with museum curators and visitors at the Croke Park Museum.

The third and final End-User Advisory Board Workshop will take place in Dublin on 28 January during the evaluation of the final REPLAY prototype. Then, a final handbook will analyse and specify the methodologies and most cost-effective hardware solutions to extend the results of the project to other TSGs.

MARIA TERESA LINAZA

REPLAY

★ Coordinated by Vicomtech in Spain.
★ Funded under FP7-ICT.
★ http://cordis.europa.eu/project/rcn/106860
★ Project website: http://www.fp7-replay.eu/

NANOTECH TOOLS OFFER AFFORDABLE, ACCURATE HISTORICAL PAINT ANALYSIS

A nanotech-based clinical diagnosis kit for analysing ancient layers of paint promises conservation professionals cost reductions and greater accuracy.

Developed through the EU-funded NANOART (Nano Art Research Tool) project, the new testing kit has already been applied to identify binders such as collagen and ovalbumin in ancient paint, not only in model samples painted in the lab but also in real samples collected from works of art.

'Once fully completed, our new tool will be made available to conservation scientists from around the world at an affordable cost (an assay can cost around EUR 0.50 per target), which will facilitate greater knowledge about historical works of art and help international museums, restoration art studios and laboratories to plan the best conservation and preventive strategies,' explains NANOART project coordinator Dr Jesus de la Fuente from the CSIC/University of Zaragoza, Spain.

In addition, the sensitivity of the project's new nanotechnology-based methods means that smaller samples are required to be taken from the artwork for analysis. This in itself will help to better preserve our cultural heritage.

In order to characterise ancient paints, experts have often relied on conventional molecular biology methodologies that were developed decades ago. The concept behind the NANOART project was that these techniques could be substituted by more sensitive, inexpensive and faster techniques that take advantage of emerging nanotechnologies.

Furthermore, conventional methods — apart from being expensive — are also only available at a few laboratories, and require specialised personnel and equipment. A key objective of the NANOART project has been to address the cost issue by applying techniques developed for clinical diagnosis. In this way, the project is also highly original as it aims to take the latest developments in clinical medicine and apply them to the conservation and preservation of cultural heritage.

'The innovative nature of the project is also denoted by the fact that there is currently no method or kit available that can be easily used at point-of-care to analyse paints without requiring expensive equipment and extensive training,' says Ana Claro, research fellow from the INA/University of Zaragoza. 'With the NANOART kit, the final user will be able to conduct an affordable analysis (in some cases at the cost of only a few euros) by simply following the instructions. Within a four-hour period, the results will be available.'

The potential opportunities opened up by the new analytical nanotechnology are huge. For example, developed in parallel with the NANOART kit, a spin-off company called NanoImmunotech has been launched in order to develop devices to detect bacterial infection in meat using the same technology as used in NANOART.

'This opens our technology to other applications far from cultural heritage applications,' says de la Fuente. 'However, we would like to continue further developing novel uses of NANOART technology for other applications in cultural heritage, and our next step will be to look for funding to develop an even more user friendly device.'

NANOART

★ Coordinated by the University of Zaragoza in Spain.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/project/rcn/107275

INTERVIEW

NEW TECHNOLOGIES AND TOOLS TO MAP AND PROTECT UNDERWATER TREASURES

Our seas and oceans are home to a tremendous amount of archaeological sites and artefacts. These invaluable witnesses to history are often difficult to locate, and even then experts are still faced with the question of whether to conserve them *in situ* or bring them to the surface. The SASMAP project has developed tools and technologies that will help solve both conundrums.

The value of underwater cultural heritage no longer needs to be proven. According to UNESCO estimates, some 3 million shipwrecks are spread across the world's ocean floors. And that's without counting submerged heritage sites: In Denmark alone, where the 'UNESCO Scientific Colloquium on the Access to Underwater Cultural Heritage' will take place from 8 to 9 June 2016, around 20 000 sites can be found. It therefore comes as no surprise that the National Museum of Denmark, as coordinator of the SASMAP project, set out to help archaeologists to better map and protect these hidden treasures.

The SASMAP concept was born from two main observations. The first one is that the huge potential of underwater cultural heritage is in contrast with how it is undervalued. The Vasa Museum in Sweden, for instance, attracts as many as 1 million visitors per year largely thanks to its huge Swedish warship of 1626 that was recovered in 1961.

The second one, and the most important, is that excavation is not always the most realistic and preferable option. As pointed out on the SASMAP website, 'a single large wooden wreck, such as the Mary Rose in the UK, has to date cost ca. EUR 80 million to raise, conserve and exhibit, whereas the physical *in situ* preservation of a similar sized wreck in Sweden cost around EUR 0.07 million'. Sometimes bringing such cultural heritage back to the surface can also damage it beyond repair.

Dr David Gregory, coordinator of SASMAP, explains how the project's tools and technologies will help archaeologists in their quest to locate and analyse heritage sites, but also to decide on the best conservation option.

★ What are the main problems related to locating and conserving underwater sites?

Dr David Gregory: I will try and answer this question in two parts. Firstly, the issue of locating, and secondly, matters relating to conservation. Locating sites is generally difficult as sites are underwater and this makes diver-based searches far more labour-intensive and expensive. These operations are often hampered by poor visibility and arduous working conditions. Furthermore, even though one often has the picture of a shipwreck sitting on the seabed, prehistoric remains and landscapes are often buried, and so are more ancient shipwrecks. This has been solved with an increased use of acoustic survey techniques that can very accurately predict, record and model what is lying on the seabed and within the seabed. A new type of acoustic device that can look into the seabed in 3D has also been developed within the project and is already being taken up by other marine researchers, not just archaeologists but also geologists, etc.

Now in terms of conservation, there are two aspects to consider — one is what is called *in situ* preservation, that is to say locating, documenting, protecting and monitoring sites where they lie on the seabed. This approach is very much the current ethos within maritime archaeology both at a European level and internationally — there are several treaties which argue for this approach. However, sometimes *in situ* preservation is not appropriate as sites are at risk of


© SASMAP