

The Marie Skłodowska-Curie ITN-DCH Project – Overview and Scientific Work

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ABSTRACT

As multidisciplinary research continues to unite different investigation methodologies, an EU-funded project has been formed to equip a group of PhD and postdoctorate researchers in the field of digital cultural heritage with a training framework which connects academia, research institutions, and private industry. The Initial Training Network for Digital Cultural Heritage (ITN-DCH) has brought together some of the leading actors in this sector from across the European Union in order to achieve the challenging task of developing a holistic framework for digital cultural heritage. The following paper offers an overview of the project and its investigative focus. By exemplifying this research strategy on four case studies, the project will focus on all aspects of cultural heritage, from the tangible to intangible.

1. INTRODUCTION

From the perspective of traditional academia, disciplines are usually divided between the humanities and sciences. In recent years, however, this separation is growing less rigid as multidisciplinary research efforts evolve in order to address new and complex research questions. Digital cultural heritage is one such developing discipline which rests equally between humanities, science and engineering. The challenge is this: how can young researchers uniquely enrich their studies and training in a field that rests across diverse yet long-established academic standards? The Initial Training Network in Digital Cultural Heritage (ITN-DCH) has sought to respond to this challenge by training 20 EU-funded PhD and postdoctoral researchers within a network of public and private institutions from across Europe. The goal of the project is to develop a holistic framework that utilizes the inter-sectorial focus of cultural heritage research while addressing all of the aspects which it entails, from tangible objects to intangible content.



Figure 1: Location-based overview of project partners and fellows (Credit: 7reasons).

2. PROJECT OVERVIEW

Beginning in October of 2013, with a duration of four years, the ITN-DCH project represents one of the largest Marie Skłodowska-Curie Actions funded by the European Union's Seventh Framework Programme. The project recognises how cultural heritage is an essential component for Europe and contributes to defining a common European identity at the same time acknowledging its importance of social and economic development in the region. Coordinated by the Digital Heritage Lab at the Cyprus University of Technology, under the direction of Dr. Marinos Ioannides, the project links a diverse range of European actors in digital cultural heritage including universities, research institutions, private industries, museums, archives, and libraries as shown in Figure 1.

2.1. Project Partners

The heterogeneity of research areas that are represented by the project's full and associate partners demonstrates how its objectives can be approached through synergic investigation. If considered as a linear methodological sequence for digital cultural heritage, each participant represents a part in the chain connecting academia, research institutes, and private industry, as illustrated in Table 1.

Full Partners		Associate Partners
Digital Heritage Research Lab, Cyprus University of Technology	UNIGE-MIRALab, Universite de Geneve	Réunion des Musées Nationaux et du Grand Palais
LMSE and Photolab National Technical University of Athens	Centre National de la Recherche Scientifique (CNRS- MAP)	Faculty of Civil Engineering, University of Zagreb
Institute for Photogrammetry, University of Stuttgart	digitalMED, Universidad de Murcia	Archäologische Staatssammlung München
Computer Vision, Robotics and Information Systems Laboratories, Foundation for Research and Technology – Hellas (FORTH)	Faculty of Civil and Geodetic Engineering, University of Ljubljani	Commission for Archaeology of Non-European Cultures, German Archaeological Institute
Fraunhofer IGD	7reasons Media GmbH	Cyprus Broadcasting Corporation
Katholieke Universiteit Leuven	ArcTron 3D GmbH	Dachverband Tanz Deutschland
Fondazione Bruno Kessler (FBK-3DOM)	Visualisation Group, University of Warwick	Centre for Research and Technology – Hellas

Table 1: ITN-DCH Project Participants.

2.2. Project Fellows

At the time of writing, 17 of the 20 proposed research positions have been filled by both doctorate and postdoctorate researchers in 11 European countries. The diversity of their backgrounds and research foci range from archaeology, architecture, history, geodesy, civil and chemical engineering, semantics, computer science, mathematics, philosophy and physics. Collectively, these fellows embody the multidisciplinary development of digital cultural heritage.

3. RESEARCH AND TRAINING METHODOLOGY

3.1. Work Packages

The following list and brief descriptions illustrate the focus areas to be achieved during the project by the project fellows.

3.1.1. Cultural Heritage Data Definitions, Requirements and the Metadata Description Interface

Definition of a complete metadata interface able to represent the new forms of cultural heritage assets, including 4D and the intangible, is proposed in order to allow interoperability and backward compatibility with existing specs used in cultural heritage libraries, such as Europeana.

3.1.2. Capturing and Digitization Technologies in Cultural Heritage

Promote a scalable acquisition methodology by combining multi-view cameras, depth sensors and TOF cameras for generating high resolution 3D/4D point clouds with textured data under an affordable framework and focus on approaches that increases capturing resolution through the incorporation of advanced signal processing tools and self calibration/registration methods.

3.1.3. Data pre-/post-processing (2D, 3D), Computer Vision and Computational Geometry

Automate a modelling process with regard to tangible and intangible content, including the case of complex backgrounds, moving objects and severe occlusions.

3.1.4. Semantic-Symbolic and Conceptual Representation

Research in inherently inter-related ways of expression, style and emotional properties with tangible CH assets, and on synchronization, especially in cases where multiple moving objects are encountered in the digitization process.

3.1.5. Digital Cultural Applications

Incorporation of physical cultural heritage assets with virtual objects and additional knowledge derived from intangible information for perceptual and real-time rendering, human animation, storytelling, synchronization, incorporation of geo-information, and virtual synthesis of the entire environment.

3.1.6. Cloud Services in Digital Cultural Heritage

Quality of Service (QoS) in cloud computing architectures and improving data acquisition using cloud computing services.

3.1.7. Dissemination, Outreach, and Standardization Actions

The results of the project will be presented in a number of ways such as international public events associated with the European Researchers Night, ICOM International Museum Day, European Heritage Days, and UNESCO/ICOMOS International Day for Monuments and Sites, for example. Multilingual press conferences, bulletins, and interviews will be arranged for relevant magazines and newspapers. Additionally, a web portal to openly share the results of the project is also planned.

3.2. Case Study of Asinou Church

In order to realise the holistic framework, four varying case studies are to be brought into focus by the project fellows' research development and training. The first case study is the UNESCO World Heritage Site of Panagia Forviotissa Asinou, a Byzantine-era church located in the Troodos Mountains of Cyprus. From its founding in the 12th century, this church is composed of a heterogeneous ensemble of cultural heritage information ranging from historic inscriptions and frescoes to contemporary media (Sofokleous et al., 2006; Georgopoulos et al., 2008). This case study is unique from the others due to the fact that its structure remains to be similarly utilised for religious devotion since its construction. Acquisition work has already been accomplished by different partners and fellows. The early stages of development have also been achieved to provide an online web portal for data unification, management, and dissemination (Coughenour et al., 2015; Figure 2).

Asinou Viewer



Figure 2: Web portal utilising WebGL for integrated dissemination.

3.3. Case Study of Donaustauf

The Castle of Donaustauf near Regensburg is another case study of the project (Figure 3). Although several historical documents place its construction near the beginning of the 10th century, archaeological excavations have found evidence of occupation on the hilltop dating back to 500 BC. ArcTron3D, a full project partner, is organizing the acquisition and processing campaign for this case study. At the time of writing, some of the fellows are participating in a combined secondment training activity at ArcTron3D in order to integrate data collection and dissemination using a structured light scanner, terrestrial laser scanner, aerial and terrestrial photogrammetry, as well as traditional surveying methods. The newly acquired data will be compared and integrated by the fellows into the previously gathered reference dataset which includes aerial images taken from an ultralight paraglide trike as well as laser scanner and photogrammetric data (Schaich, 2012).



Figure 3: Aerial View of Donauauf Castle (Credit: ArcTron3D).

In addition, two other investigation methodologies will be accomplished. First, there are traces of 12th century paintings on the preserved walls of the chapel. Structured light scanning, photogrammetry, and infrared/hyperspectral imaging will be applied to strengthen the documentation and allow fellows to conduct specialised research strategies once they return to their home institutions. Finally, the creation of 4D representations of the castle gates has also been proposed as an additional task for the fellows by integrating historic sketches, previous archaeological investigations, ArcTron3D's prior dataset, and the acquisition completed by the fellows.

3.4. Case Study of Ilmendorf

A Hallstat-period woman's tomb from the 8th to 6th centuries BC is an additional project case study. Discovered in Ilmendorf in 2010, the excavation was carried out by the firm KANT in Ingolstadt. Two blocks have been retrieved and contained the remains of a bronze belt, bronze pins, glass rings, among other items (Claßen et al., 2010). The computed tomography analysis has been completed by Britt Nowak-Böck of the Bayerisches Landesamt für Denkmalpflege and will be assimilated into the integrated documentation strategy of the fellows. The archaeological findings are currently located in the laboratories of Archäologische Staatssammlung München, an associate project partner, where the fellows are currently realising an acquisition plan during their secondment at ArcTron3D (Figure 4).

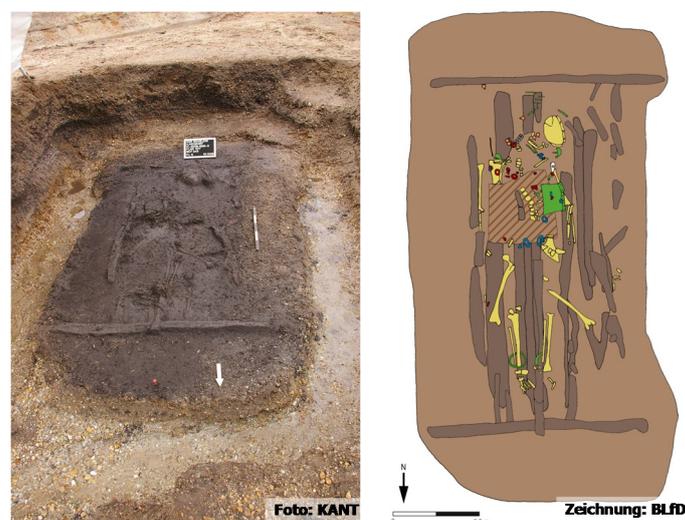


Figure 4: Excavation unit (left) and its survey (right) (Credit: Bayerisches Landesamt für Denkmalpflege).

3.5. Case Study of Carnuntum

Finally, Carnuntum Archaeological Park, located outside of Vienna, Austria is also a case study organized by 7reasons. Since this site has been thoroughly investigated since the 19th century, there is an enormous amount of collected data available from traditional archaeology, geophysical prospection, and virtual/physical reconstructions. This case study provides the fellows with an example of a complex archaeological dataset at different levels of scale (object, architecture, urban, and landscape) from a multidisciplinary research effort that has been developing over the years (Figure 5). The emphasis on this case study is not data acquisition, but rather for the fellows to find innovative ways to use this complex dataset for achieving novel integration and dissemination methodologies.

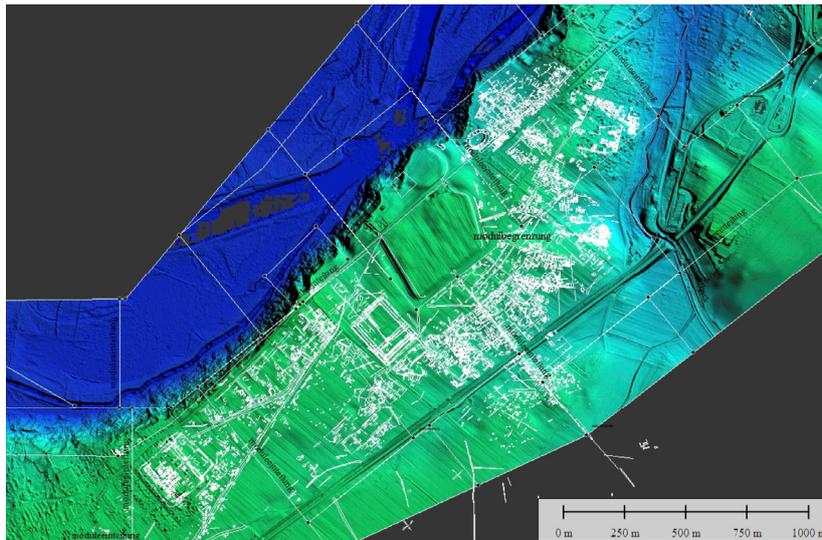


Figure 5: Carnuntum Landscape (Credit: 7reasons).

4. CONCLUSIONS

The emerging field of digital cultural heritage requires innovative improvement that is better accomplished by constructing a project with the intention of training the next generation of researchers. While the project's midpoint is only now passing, the ITN-DCH project aspires and has begun to achieve the design of a framework that integrates previous documentation methodologies with recently developed technology and research strategies for the full life-cycle of digital cultural heritage. With the support of the project partners, the fellows have the challenging task of collaboratively organising themselves to achieve their goals. From the tangible to the intangible, the documentation, investigation, preservation, and dissemination of our shared, global heritage is a vital educational tool, for researchers, private industry, and the general public.

5. ACKNOWLEDGEMENTS

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