cnr DIITET
Consiglio Nazionale delle Ricerche
Engineering, ICT and Technologies for
Energy and Trasportation Department

Project Area 11
Technologies for Cultural Heritage Use and Preservation

July 2018

Project Area 11: Technologies for Cultural Heritage Use and Preservation

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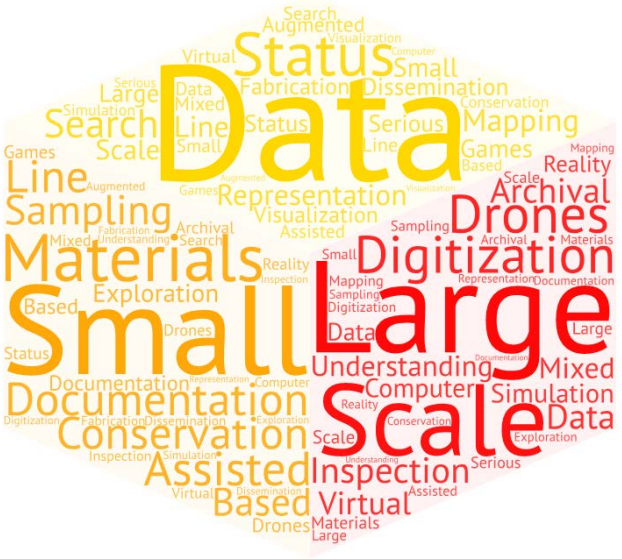
Objective:

Design, implement, assess and experiment on the field digital technologies for the digitization, analysis and preservation of **tangible and intangible** cultural heritage.



Approach:

DIITET's contributions have been organized according to three main themes of Cultural Heritage:

1. documentation/diagnosis
2. representation
3. dissemination

whose interdisciplinary nature requires a collaborative approach that can go beyond our departmental Institutes.

Activities exploited by 9 CNR institutes with a critical mass of 80 researchers and 34 full-time equivalent units.

Scientific Impact/Results:

- Excellent international scientific ***visibility***
- High-level ***collaborations*** with many CH institutions and governing bodies
- Contribution to ***open source*** and technological transfer
- Many active research projects, funded on competitive calls, with a CNR budget of more than 6ME

1. Documentation

Methodologies and technologies (HW and SW) for **digitizing** the shape characteristics or the material/surfaces properties, or for **diagnostic analysis** of the conservation status, up to sampling intangible CH assets - a mandatory first stage for any computer-assisted management of CH assets. It is organized in:

1.1 Small-Large Scale Digitization

1.2 Materials and Conservation Status Sampling

1.3 Drones-assisted inspection

1.1 Small-Large Scale Digitization

Technologies for 3D and 2D digitization (active and passive scanning, RTI, etc.)

Sampling and reconstructing: **shape**, **colour**, **surface reflection** characteristics, sampling both visible and non-visible bands (hyperspectral)

Video:
Sarcofago degli Sposi https://www.youtube.com/watch?v=iwjSDvqmMjc

1.2 Materials and Conservation Status Sampling

Technologies for sampling the **reflection properties** of the surfaces under different wavelenghts or investigating the **chemical and material composition** of artworks.

Instruments producing insights on the artwork and its production, extremely useful for assessing the conservation status.

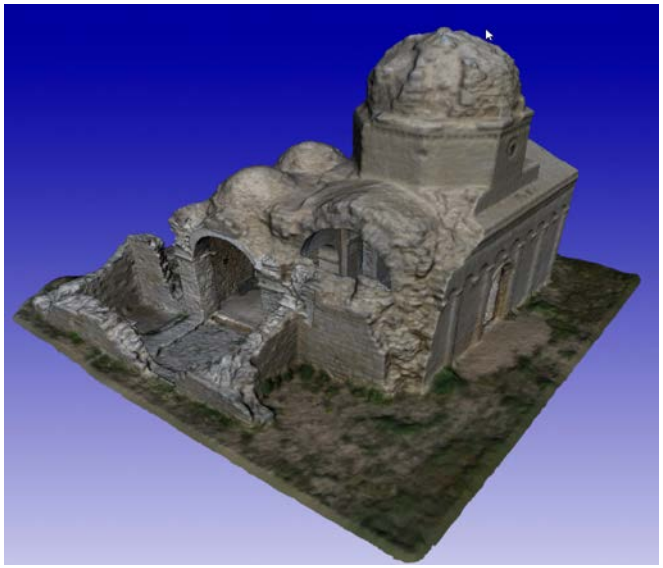
Video:
Hyperspectral acquisition: https://youtu.be/SweoPkBTj5Q

1.3 Drones-assisted inspection

Unmanned vehicles, or **drones**, working either in **air** or **underwater**, improve considerably our sampling capability.

These devices offer advantages in **speed, safety and cost of acquisition**, also allowing the user to inspect areas that are difficult to be accessed.

They also allow extending the sampling scale and scope (from satellites to small drones) and allow performing cost-effective and regular monitoring of CH sites.



Video:
Modello 3D realizzato con riprese da drone e da terra https://www.youtube.com/embed/jFE9BZ6wOPs

2. Data Representation and Understanding

The focus here is how to manage the **multi-dimensional** and **multi-source data** gathered, to support inspection, analysis and insight:

2.1 Data Mapping and Archival

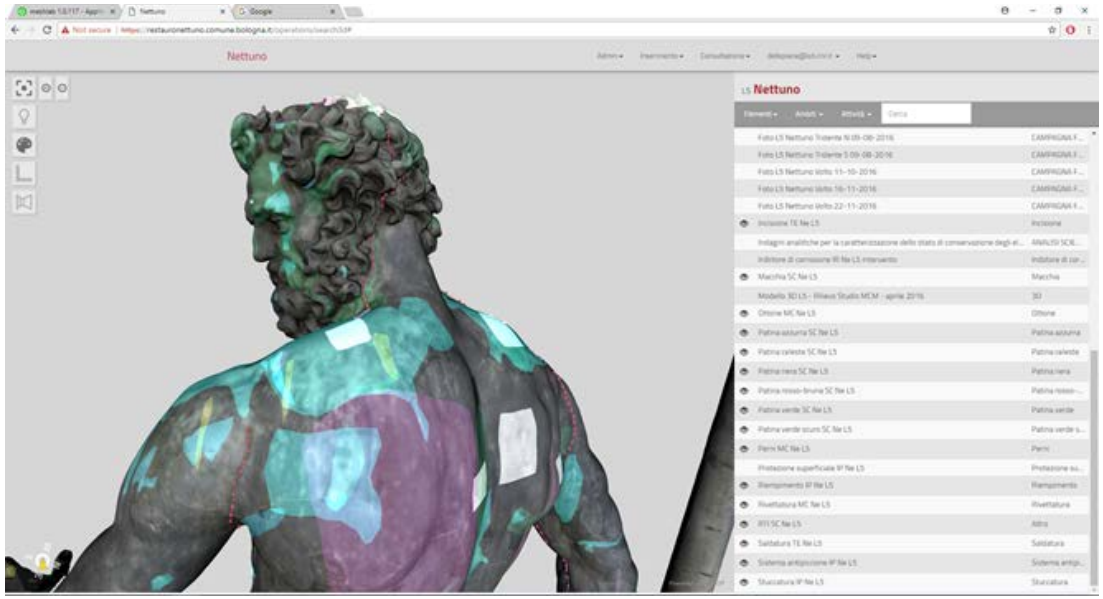
2.2 Data Search and Exploration

2.3 Computer-based simulation

2.1 Data Mapping and Archival

Technologies for **data integration**, to support visual **analysis**, to enrich visual models with **metadata** and to **preserve**

- Multiple datasets
- Ontologies
- Knowledge management
- Interactive data access&Viz
- Annotations
- Permanent archival
- Virtual restoration

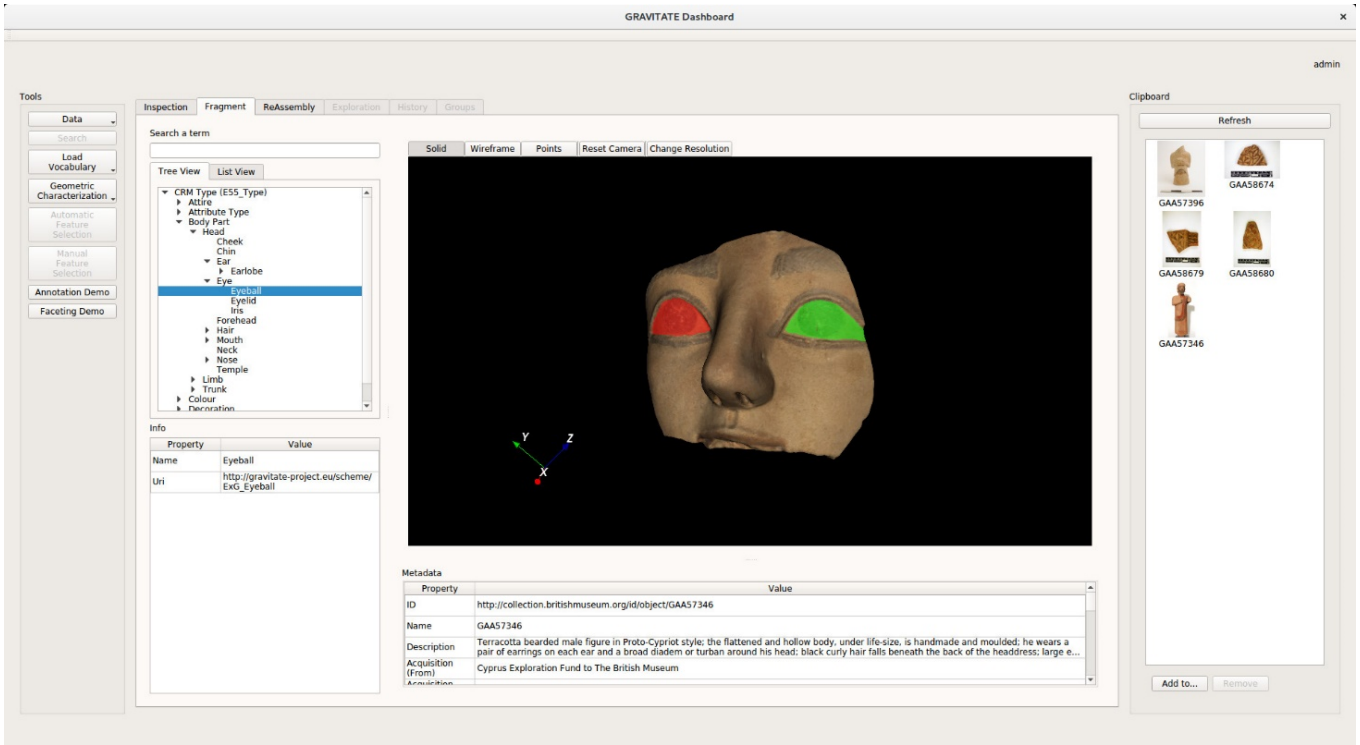


Videos:
Integration and viz of data: https://youtu.be/8wJ10y65Cz0
Restoration information system: https://www.youtube.com/watch?v=KCpUrMgTNbA

2.2 Data Search and Exploration

Solving **similarity queries** over large archives of visual data

- Tag-based vs. **similarity queries** (based on shape characteristics)
- Extraction of semantically-significant **visual/shape descriptors**
- Browsing collections of visual media

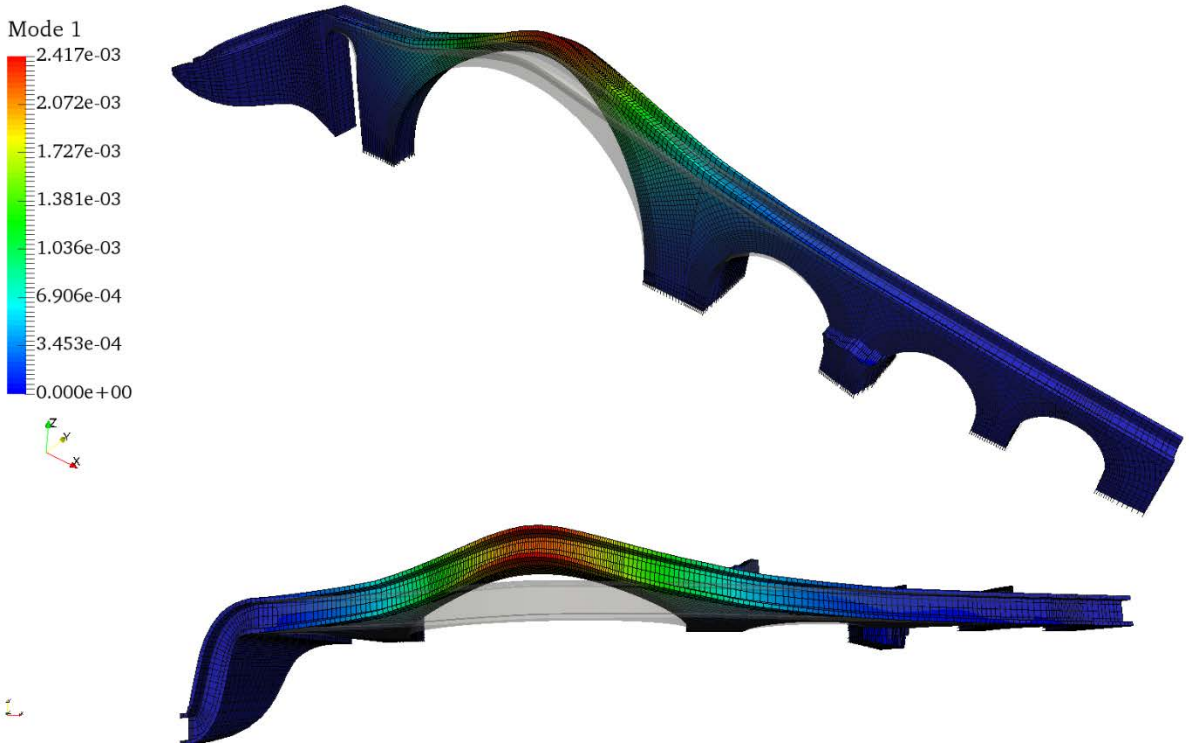


Video:
GRAVITATE https://www.youtube.com/watch?v=a3qv37nn9Jw&feature=youtu.be

2.3 Computer-based simulation

Innovative mathematical models and numerical methods for the structural analysis of historical buildings

- Finite-Element Modelling applied to 3D structures
- Mathematical models for the study of chemical and biological damages



Video:
FEM edifici storici http://www.cnrweb.tv/arriva-monster-ecco-il-monitoraggio-degli-edifici-storici/

3. Dissemination

Annotated CH resources and visual data have a great potential for dissemination to the public and to support museum and tourist applications through:

3.1 On-line Data Visualization

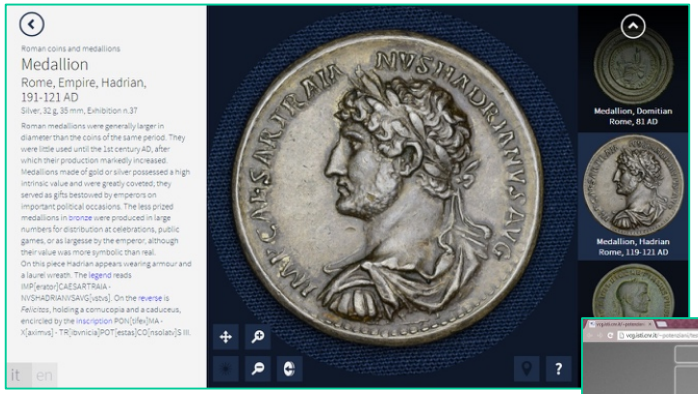
3.2 Virtual, Augmented and Mixed Reality

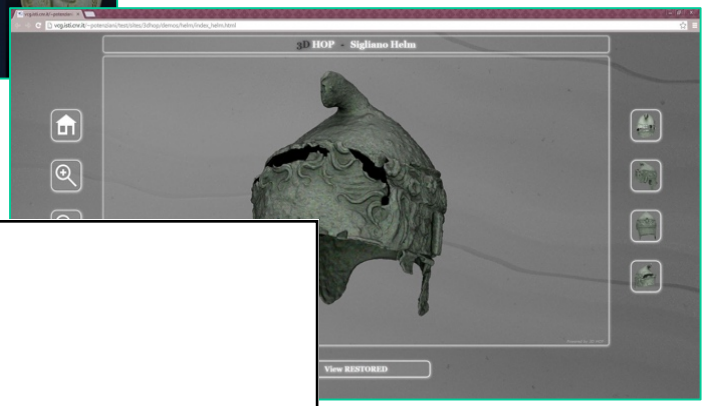
3.3 3D Fabrication

3.4 Serious Games

3.1 On-line Data Visualization

Systems and platforms for **interactive rendering** of high-resolution multimodal data, both **locally** and on the **web.**





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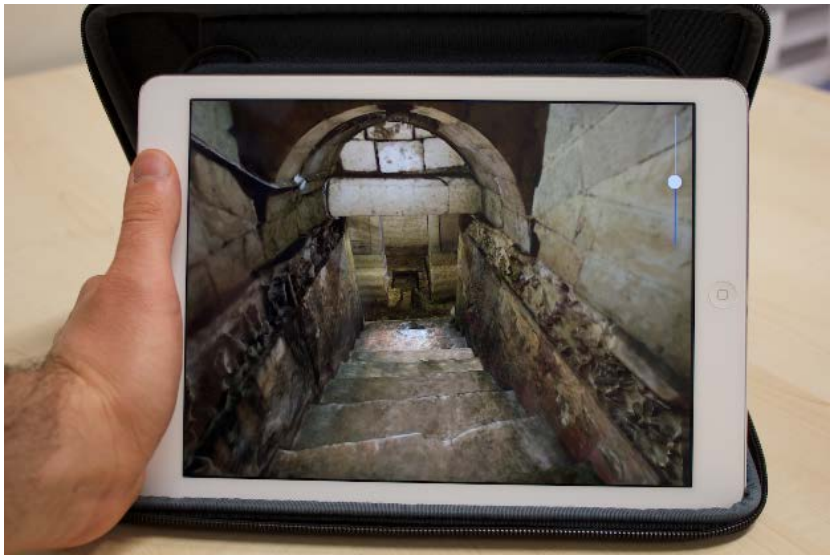
3.2 Virtual, Augmented and Mixed Reality

Virtual or **Augmented** presentation with modern I/O devices (mobile or head-mounted):

- Using mobile/VR/AR technologies to access hidden spaces or architectures
- Design new interaction modes, use AR/VR technology to deliver knowledge and data to remote users

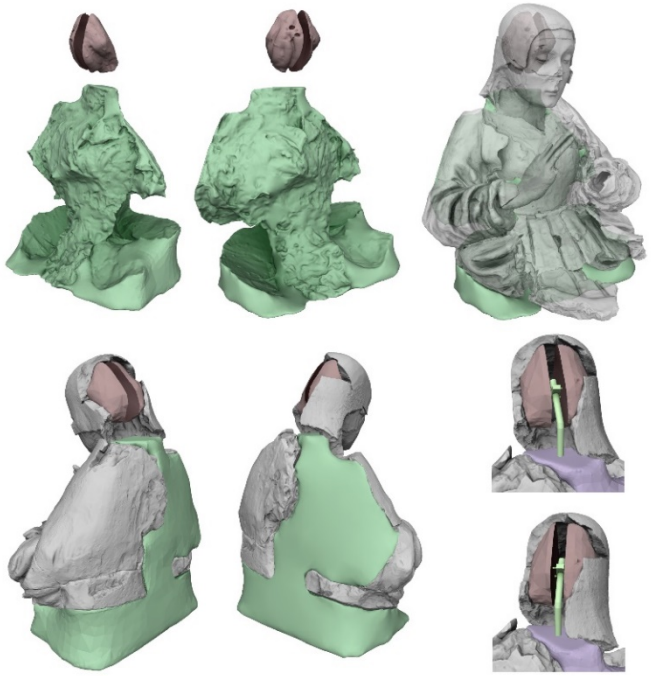


Videos:
Outdoor AR: https://drive.google.com/file/d/1CvMat8rRT4xMwHe3SHHZHyI8i_MirYpE/view?usp=sharing
Virtual tour: https://www.youtube.com/watch?v=gIDM9Y3Syj8

3.3 3D Fabrication

Technologies able to transform a 3D model in a **physical instance** have also boomed in the last decade, thanks to the huge interest in industrial applications (Industry 4.0).

Lot of interest in CH, to either populate **museums** expositions with static and **enhanced/sensorized replicas**, to **support restoration** projects, or to improve the **impaired people perception** experience.

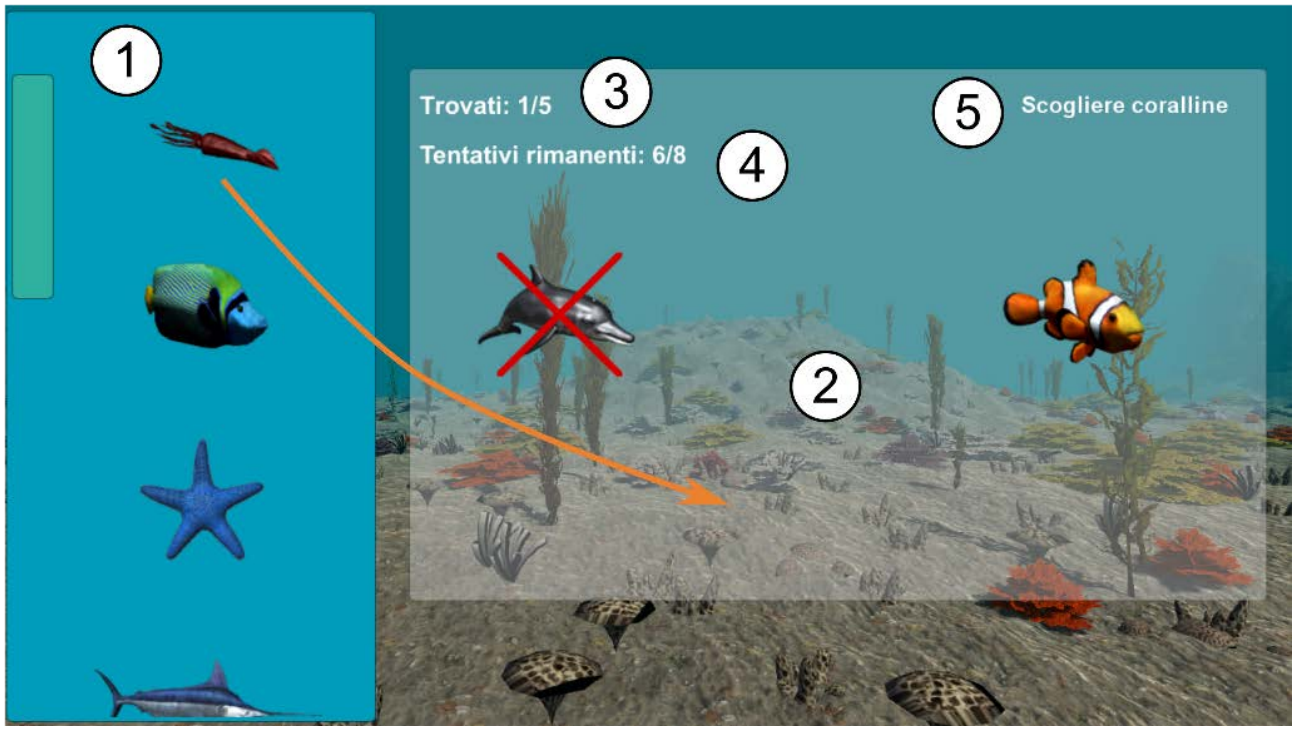


Video: Restoration Madonna Pietranico https://www.youtube.com/watch?v=2dquqRwkpqk

3.4 Serious Games

Study of the game mechanics having an impact on learning in the context of CH

Focusing on the representation of 3D worlds in role-playing games and 3D setting and immersive technologies to **facilitate engagement**, a feeling of presence in the digital environment, empathy with the game characters and learning



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