ADVANCED ACQUISITION TECHNOLOGIES

AND DIGITAL REPRESENTATION

IN THE CULTURAL HERITAGE FRUITION

NEW DEVELOPMENT TRENDS AND VALORISATION PROPOSALS

26_11_2019

UNIVERSITÀ DEGLI STUDI DI PALERMO

Dipartimento di Architettura

DARCH

DARCH

Eng. Francesco Di Paola
Docente di Disegno S.S.D. ICAR/17
Department of Architecture (DARCH)
University of Palermo
francesco.dipaola@unipa.it
389.4324760

FRUITION IN THE CULTURAL HERITAGE FIELD

Promoting an approach that considers **CULTURE**, **SAFEGUARD** and **VALORIZATION** is to be considered as one of the most important opportunities of **SUSTAINABLE ECONOMIC DEVELOPMENT** for a country and, in particular, for Italy, one of the countries with a significant cultural vocation.

The evolution is driven by the support of **NON-INVASIVE TECHNIQUES** in conservation, archaeology, art (TCT - Time Compression Technologies; ICT - Information Communication Technologies) and by the **NEW VIRTUAL PRESENTATION METHODS** in integrated multimedia documentation for the study and characterization of works of art, in museums and on the web.

These scientific contributions are radically changing the way we study, analyse and present these actions to the public.

NATIONAL OPERATIONAL PROGRAMME "CULTURE and DEVELOPMENT" European Regional Development Fund ERDF 2014-2020 Sicily Convergence Objective Region_AXIS 6
Improvement of the conditions and standards of offer and use of the Heritage in the areas of natural attraction.
Investment priorities: Support to the diffusion of knowledge and the fruition of cultural heritage, material and immaterial, through the creation of innovative services and/or systems and the use of advanced technologies.

LIST OF EU-FUNDED PROJECTS TOPICS:
- Technologies in the creativity field (assistive technologies);
- ICT for inclusive access to cultural resources to foster solutions that ensure accessibility and usability;
- Digital Preservation;
- Europeana and technology-enhanced learning.

INDUSTRY 4.0_MUSEUM ISSUE →

SUPPLY OPTIMISATION , MAKING THE VISIT ATTRACTIVE, EDUCATING

NEW DEVELOPMENT TRENDS FOR COMMUNICATION MUSEUM

- **MoMA**_Museum of Modern Art di New York

- **British Museum**

- **Louvre Museum**

- **Museo archeologico Regionale A. Salinas**

KNOWLEDGE OF THE USER AND HIS NEEDS: RESEARCH, STUDY, LEISURE, RELAXATION

MUSEUM FATIGUE: BENJAMIN IVES GILMAN 1916, FINE ARTS MUSEUM IN BOSTON EXPOSURE TO REPEATED IMPULSES, VARIETY

COMMUNICATION STRATEGIES: NEW MUSEOGRAPHIC APPROACHES 3D MULTIMEDIA TECHNOLOGIES

ACTIVE AND EXPERIENTIAL LEARNING: USER PROTAGONIST

EMOTIONAL INTELLIGENCE-FEEDING KNOWLEDGE

A gift from Athena, App del British Museum developed in partnership with Samsung Uk & Ireland

Nintendo 3DS Louvre Guide

MISSION: AUDIENCE DEVELOPMENT/AUDIENCE ENGAGEMENT

"FOR A FREEDOMLESS CULTURE" MUSEUMS TO TOUCH, ART PLACES AVAILABLE AND ACCESSIBLE TO THE BLIND AND VISUALLY IMPAIRED

The use of museums and exhibition areas by visually impaired people would require the removal of fundamental sensory-perceptive barriers as well as environmental and architectural ones for the motor disabled according to the philosophy of DESIGN FOR ALL.

OVERCOMING PERCEPTUAL BARRIERS WITH THE HELP OF ASSISTIVE TECHNOLOGIES AND ADEQUATE TYPHOID KNOWLEDGE

Typhlogists, art historians, archaeologists and engineers are studying to create the tools for overcoming these barriers.

As **Solima** remarks: "One of the main criticalities that a museum has to face is its accessibility, which is not only physical (still today an insurmountable barrier for most people with disabilities) or economic, which often makes the museum beyond the reach of the most disadvantaged sections of the population; accessibility is also cognitive, and in an even more "advanced" sense, **digital**".

L. Solima, Il museo in ascolto Nuove strategie di comunicazione per i musei statali, Catanzaro, 2012, p.22

EQUIPMENT OF ASSISTIVE TECHNOLOGIES that every museum should have:

- Panels and labels with different readable characters with respect to the background (large print), with appropriate color contrast, without overlapping images, placed at heights not excessive and adequately illuminated;

- Multisensory and multimedia tactile maps or maps with braille relief characters;

- Signalling stripes of the museum itinerary and tactile orthotics orientation routes;

- guided tours with specialized personnel and with adequate typhoid knowledge;

- Descriptions in Braille or talk about the works (audioguides, radioguides, apps, totems, automated audio guided tours);

- NFC (Near Field Communication) two-way short-range wireless connectivity with QrCode marker and the latest BEACONS Bluetooth sensors;

- "Touch tour" and "Picture This", touching finds and works or reproductions in 3D printing.

Totem multimediale

Avatar olografico

Pannellistica didascalica multimediale

Libroteca interattiva

Videomapping

Tavolo multitouch

Oggetti narranti

Multiproiezione immersiva

Programs for the blind, the so-called "Touch tour" and "Picture This" for the disabled.

Some dedicated museums in the world....

in the **United States**,
Smithsonian (with 19 museums, nine research centres and more 140 affiliated institutions worldwide, is the largest museum complex in the world);
-    Minneapolis Institute of Arts;
-    Whitney Museum of American Art di New York;
-    Museum of Modern Art;
-    il Metropolitan Museum of Art;
-    Philadelphia Museum of Art;
-    Museo d'Arte di Cincinnati.

in **Europe** :
-    Museo del Prado di Madrid

in **Italia**:
-    Galleria degli Uffizi di Firenze**;**
-    Museo Statale *Omero* di Ancona "Toccare l'arte" (esistente dal 1993);
-    Museo *Anteros* presso l'Istituto dei Ciechi di Bologna
-    Museo tattile *Borges*, Catania

NEW DEVELOPMENT TRENDS FOR THE CULTURAL HERITAGE COMMUNICATION

IN THE MUSEUM

BEYOND THE MUSEUM

SMARTPHONE E TABLET
BYOD

- DISSEMINATION MEANS
- INTERACTIVE TOUR
- PROFILING

AR/VR Visita INSIGHT

- IMMERSIVE ENVIRONMENTS STORYTELLING
- EDUTAINMENT COGNITIVE DEVELOPMENT

MAKERSPACES

- INVOLVEMENT
- PRACTICAL ACTIONS

GAMING

- ACTIVE PARTICIPATION
- LEARNING BY DOING

DATABASE

- ACCESSIBILITY
- DIFFUSION MARKETING

NMC HORIZON MUSEUM EDITION (2015-2016) MEDIUM-SHORT TO LONG RANGE OBJECTIVES IN 5 YEARS IN THE FIELD OF CULTURE, BASED ON TECHNOLOGICAL INNOVATIONS MUSEUM OF THE FUTURE

MU.SA PROJECT (2016-2019)

CREATIVE ECONOMÌA, ENTITLED "CULTURAL HERITAGE: INNOVATIVE AUDIENCE DEVELOPMENT" 2018
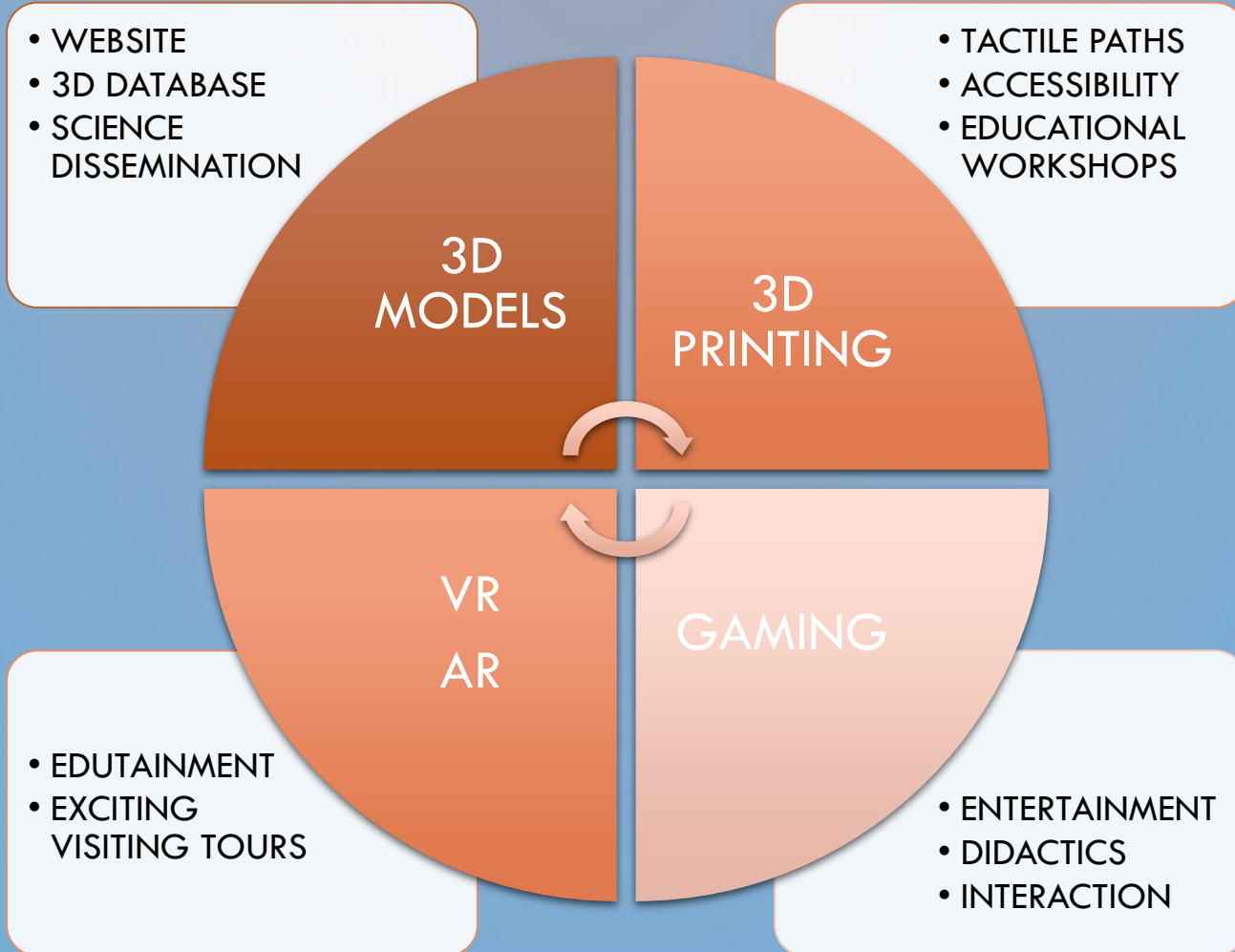
| MUSEOGRAPHIC SETTING | → | MUSEUM SUCCESS | → | PLEASANT AND COMPREHENSIBLE USE | → | 3D AR E VR TECHNOLOGY MAKE THE MUSEUM ACCESSIBLE | → | PERSONALIZED TOUR PATH WITH 3D CONTENT, VIDEOS, RECONSTRUCTIONS, GAMES |

Premium Museum Guide, Casa Batllò Barcellona
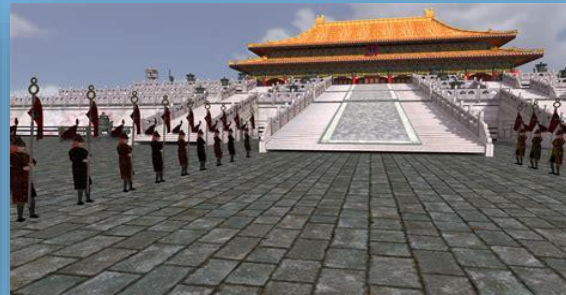
Virtual Tour of the forbidden city, available from the MAO smartphone in Turin

Paleoaquarium, Virtual Reality experience, Acquario di Genova, ETT SpA

Visit to the Teatro alla Scala Museum in Augmented Reality, ETT SpA

The Martian Virtual Reality Experience. Leonardo Da Vinci Museum of Science and Technology in Milan

Everest VR, Virtual Tour. Leonardo Da Vinci Museum of Science and Technology in Milan

VISITA INSIGHT   **BYOD**   **VIRTUAL INSTALLATIONS**   **VIRTUAL MUSEUMS ONLINE**   **GAMIFICATION**

«*ARA* as it was»

Ara as it was, frieze rebuilt in augmented reality, ETT SpA

| FROM 2016 TO 2018 ARA AS IT WAS INVOLVED 43,000 USERS MORE THAN THE ORDINARY PUBLIC | THE AR ALLOWS A NEW PATH OF VISIT, AN UNUSUAL AND EXCITING EXPERIENCE | VISUAL CONTENTS IN 3D MUSIC NARRATIVE | CULTURAL ENRICHMENT COMPARED TO THE TRADITIONAL VISIT |

Digital Innovation in Cultural Heritage and Activities Observatory

We are social, Digital Report 2018

Oculus Rift

Google Cardboard

Screenshot of the App,
"Archaeological Museum of
Milan" 3D models of artifacts

Paladini di Francia App, Carinda AR,
Antonio Pasqualino Puppet Museum

| MOBILE DEVICES DIFFUSION | ENGAGING AND INTERACTIVE CONTENT ALWAYS AT YOUR FINGERTIPS | TO CROSS THE BOUNDARIES OF THE MUSEUM: | SHARING NEW WAYS OF COMMUNICATION | EACH USER IS DIFFERENT: FLEXIBILITY TO ADAPT TO NEEDS, CULTURAL BACKGROUND | PROFILING AND MONITORING OF SATISFACTION | ENCOURAGE THE USER TO VISIT THE MUSEUM |

VISITA INSIGHT   BYOD   ALLESTIMENTI VIRTUALI   MUSEI VIRTUALI ONLINE   GAMIFICATION

VIRTUAL MUSEUM INSTALLATIONS: THE TIME MACHINE AND THE MAV

The Time Machine, Bologna

APRIL 2017 / JANUARY 201817,000 VISITORS

House of the Labyrinth, MAV Herculaneum

House of the tragic poet, Mav Ercolano

50,000 VISITORS IN 2018 MAV ON TOUR62,000 VISITORS IN 45 DAYS

VISITA INSIGHT   BYOD   ALLESTIMENTI VIRTUALI   MUSEI VIRTUALI ONLINE   GAMIFICATION

Autodesk Powers Explorer 3D per
Smithsonian Institution
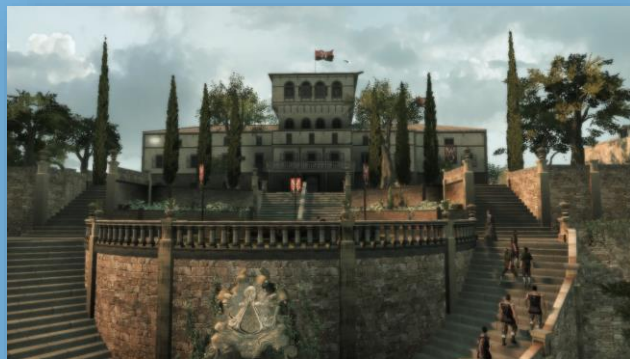
Screenshot del videogame Assassin's Creed II, Castello di Monteriggioni

Screenshot del gioco, Time Explorer, Minecraft_British Museum
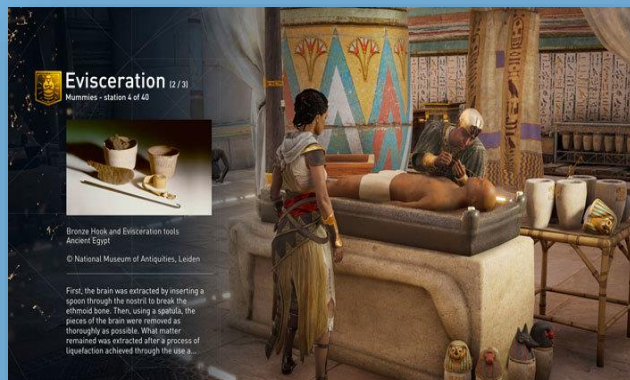
Discovery Tour by Assassin's Creed: Ancient Egypt

Rome Reborn, Foro Romano

SERIOUS GAMES:

MUSEI VIRTUALI INTERATTIVI

PROTOTIPI E SIMULATORI

GIOCABILI OVUNQUE NEL MUSEO E FUORI

FLESSIBILITÀ, LA VELOCITÀ DI APPRENDIMENTO DIPENDE DAL GIOCATORE

STIMOLANO LA CAPACITÀ DI AFFRONTARE NUOVE SFIDE, DI LAVORARE IN SQUADRA E DI RISOLVERE PROBLEMI

| LEARNING BY DOING | CREATIVITÀ DIVERTIMENTO | PROBLEM SOLVING | AUDIENCE ENGAGEMENT | RAGGIUNGE UTENTI CHE ABITUALMENTE NON VERREBBERO AL MUSEO | FRUITORE PROTAGONISTA |

VISITA INSIGHT   BYOD   ALLESTIMENTI VIRTUALI   MUSEI VIRTUALI ONLINE   GAMIFICATION

STRATEGIA PER COINVOLGERE IL PUBBLICO PIÙ GIOVANE

DESIGN PROGETTAZIONE STAMPA 3D

MUSEI FUCINA DI CULTURA CREATIVITÀ

APPRENDIMENTO PARTECIPATIVO

AVVICINARSI AGLI UTENTI CON ATTIVITÀ PRATICHE COSTRUTTIVE DIDATTICAMENTE VALIDE

Rodin Remix, screenshot della pagina Instagram del Portland Museum of Art
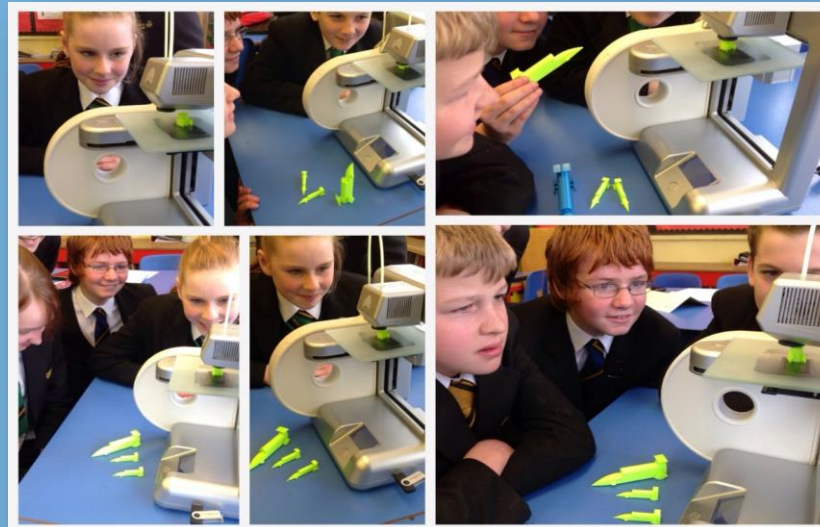
Laboratorio di stampa 3D

MISSIONE DEL MUSEO: EDUCAZIONE

CREARE DIALOGO TRA UTENTI ED OPERE

MOTIVARE ALL'APPRENDIMENTO

VISITA RICCA DI STIMOLI

ATTIVITÀ DIDATTICHE COINVOLGENTI E LUDICHE

ESPLORAZIONE TATTILE DI MANUFATTI ALTRIMENTI INTOCCABILI

COPIE IN 3D   MERCHANDISING   PERCORSI TATTILI   MAKERSPACES   LABORATORI DIDATTICI

Digital acquisition e digital fabrication

To name a few virtuous initiatives, the Association for Research into Crimes Against Art (Arca) has activated a series of actions to counter deplorable actions of destruction and to protect the cultural heritage at an international level from catastrophic natural events.

Italy participates with the newly created task force made available to UNESCO: the "**Blue Helmets**" of culture.

Reproduction in scale 1:3 of the **Arch of Bel in Palmira (Syria)** destroyed by the militiamen of Isis in 2015 armed with explosives and pneumatic hammers.

The international project The Million Image Database, funded by the Institute for Digital Archaeology (IDA) in Oxford, allowed the 15-metre high digital copy to be temporarily exhibited in the famous London Trafalgar Square during World Heritage Week last April (https://goo.gl/5wfzm4).

3D PRINTING FOR THE ENHANCEMENT OF CULTURAL HERITAGE

Laser scanning of Michelangelo's prisoners in the Louvre in Paris

PROTECTION OF WORKS OF ART LOANS

ACCESSIBILITY

ECONOMIC SUSTAINA-BILITY FINE COPIES
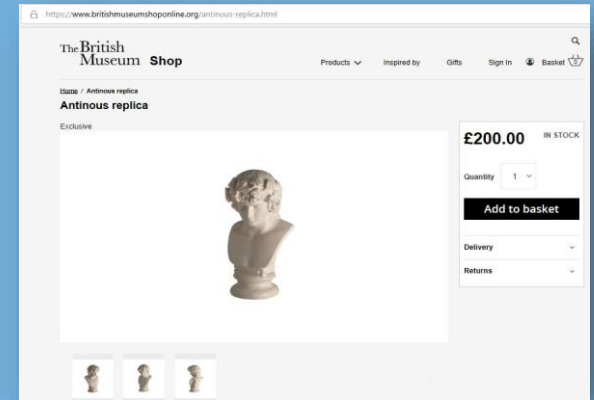
Screenshot of the British Museum's online shop website

Visual-tactile route dedicated to the Tomb of Julius II, inside the Basilica of San Pietro in Vincoli, Rome

Bust of Eleonora of Aragon by Francesco Laurana, 3D model, printing process

COPIES IN 3D   MERCHANDISING   TACTILE PATHS   MAKERSPACES   EDUCATIONAL   WORKSHOPS

Sicilian service based in Bagheria with a 7-axis CNC robotic system.

This technology consists of an ABB anthropomorphic robotic arm with a high power electro-spindle, a series of tools for machining various materials with different degrees of finish, a fixed table and a motorized rotary table that makes possible even the most difficult machining.

http://www.engimark.it/

3DPhotoworks

is a company founded in 2008 by photographer John Olson that develops and designs 3D prints for people with visual disabilities.
The aim is to make paintings and photographs in major museums and international exhibitions accessible so that blind and visually impaired people can experience the art around them.

Italian project
Tooteko_Talking Taktile (2014),

The aim is to make art accessible to the blind through a system that combines touch and hearing.It starts, in fact, from tactile tables integrated with sensors that, thanks to Arduino technology, allow you to send audio information thanks to the NFC system.

3D PRINTED REPLICAS
Embedded with sensors

Supporto tattile con Hot Spot braille-NFC

Applicazione per la riproduzione
di contenuti video su Smartphone/Tablet

Anello lettore NFC e tramsettitore wireless
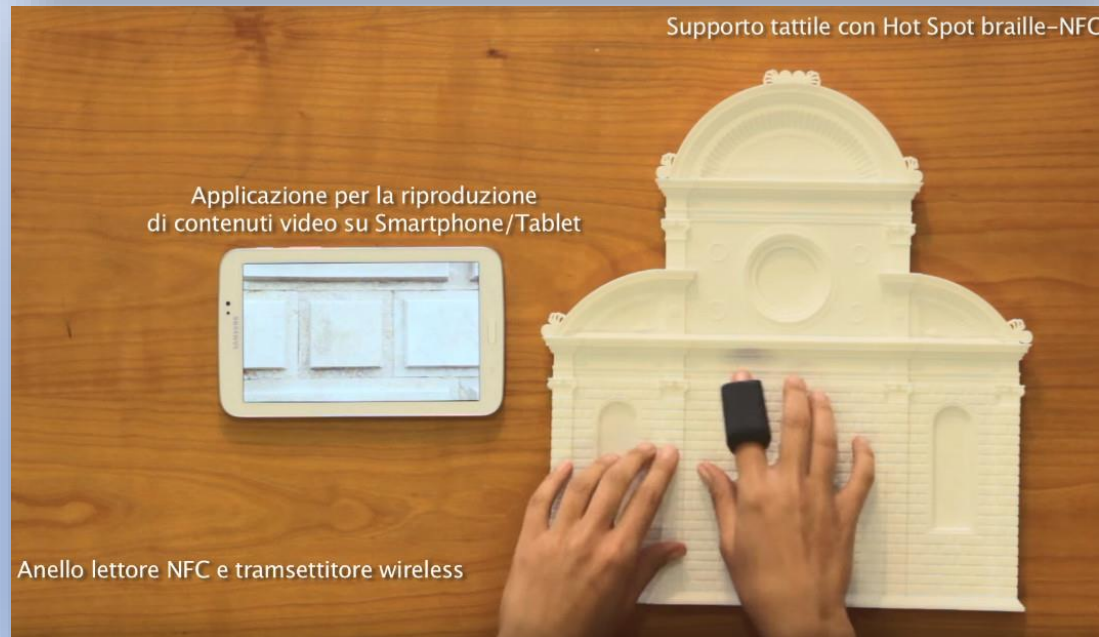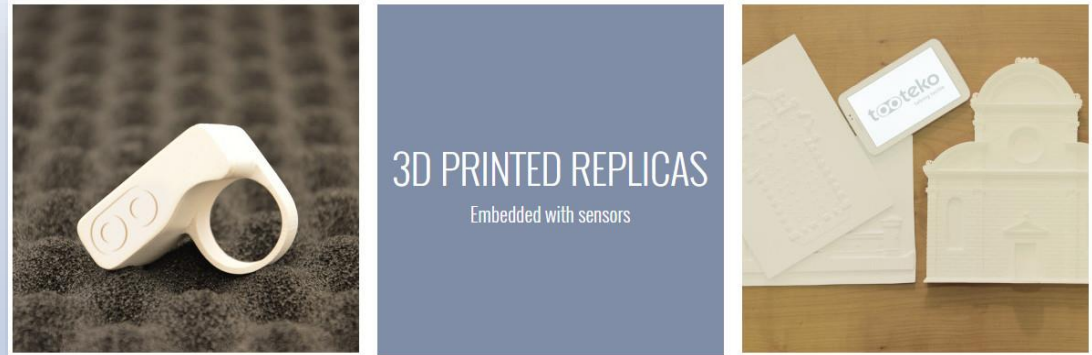
Milan, Churches accessible to all: here are the thermoformed panels for the blind

"Churches of Milan in every sense." multisensory and multimedia panels and thermoformed boards for the blind in fifteen city masterpieces(2016)
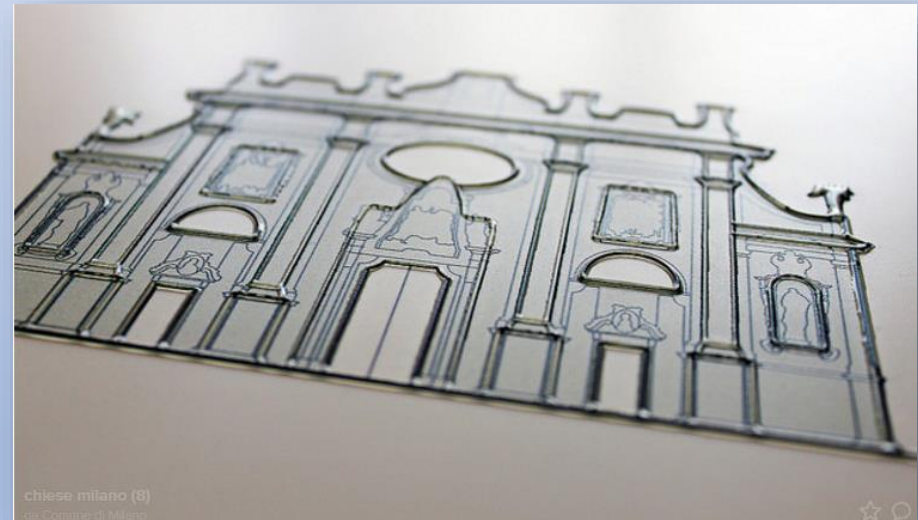
3D DETECTION

Measurement of the visible (external) surfaces of an object in the 3 spatial dimensions. For each acquired point the coordinates x, y, z are calculated.

Modern scanning systems detect millions of points in a short time, allowing the colour information recorded by the sensor itself or by an integrated external digital camera to be associated with the points.

Derivation of a set of unstructured 3D points ("point cloud") to describe approximately the geometric shape of the object in a virtual space that has as a reference system the one related to the instrument.
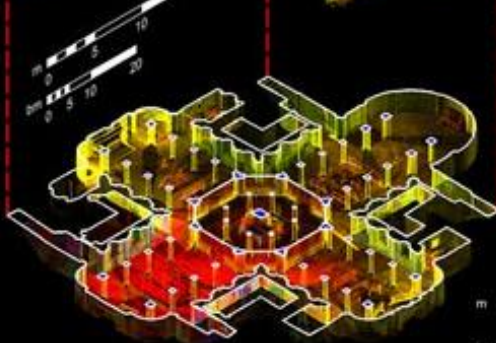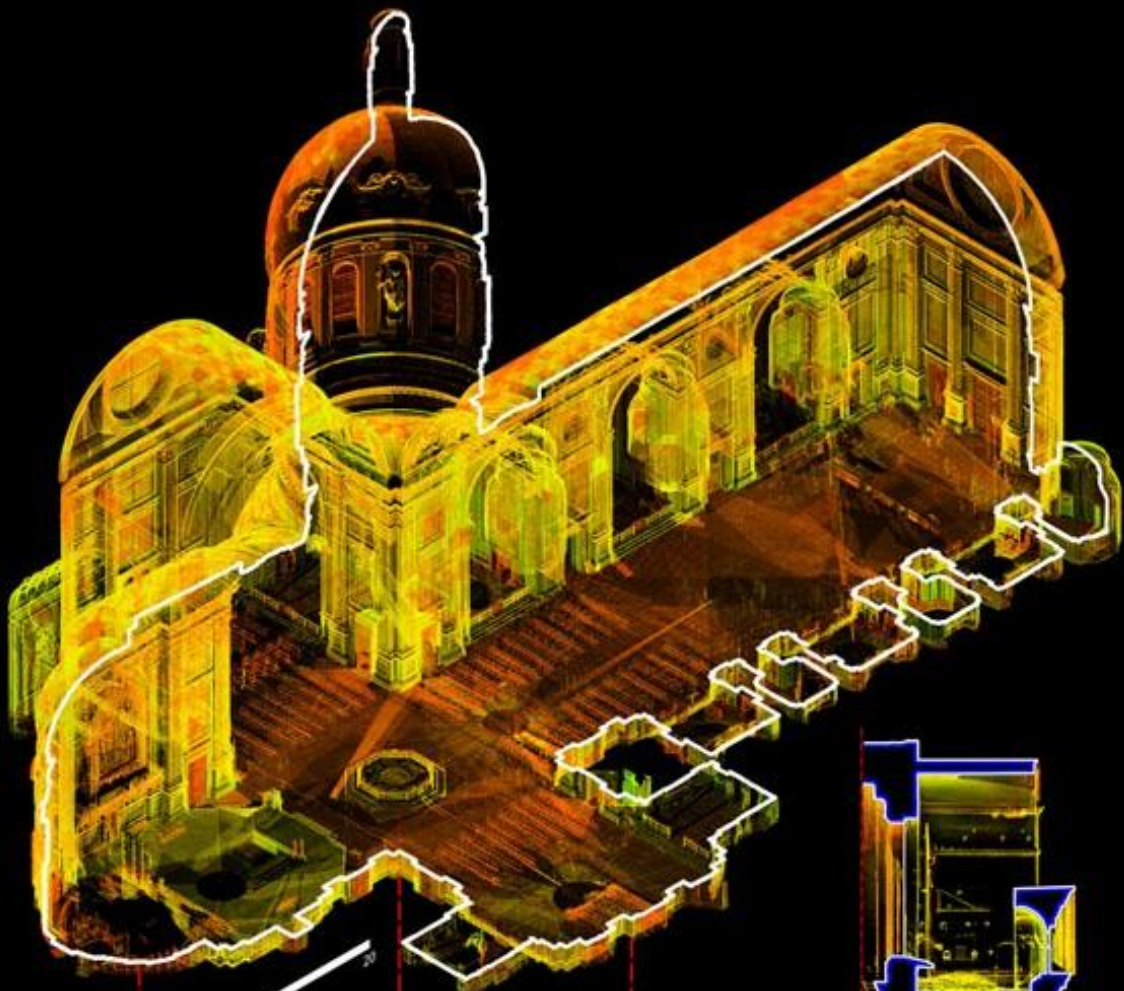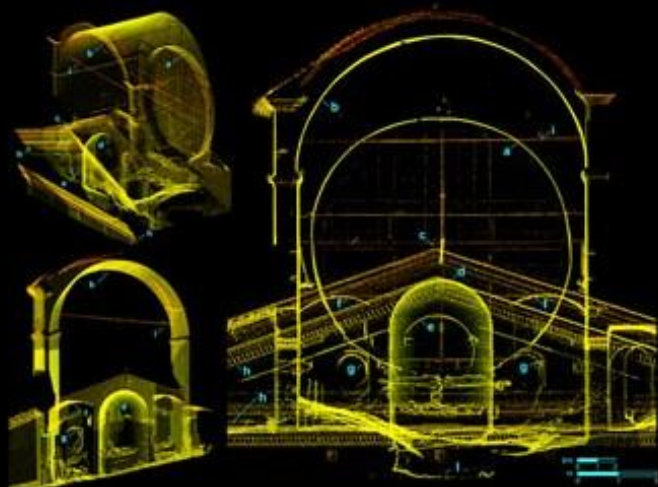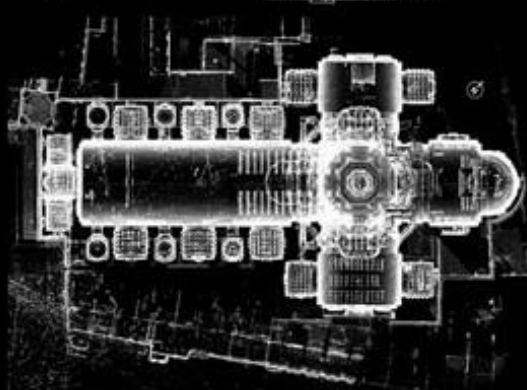
Tecniche *image-based* (*Structure-from-motion, SfM*)

L. De Luca. «La Fotomodellazione architettonica. Rilievo, modellazione, rappresentazione di edifici a partire da fotografie», Dario Flaccovio Editore, 2011.
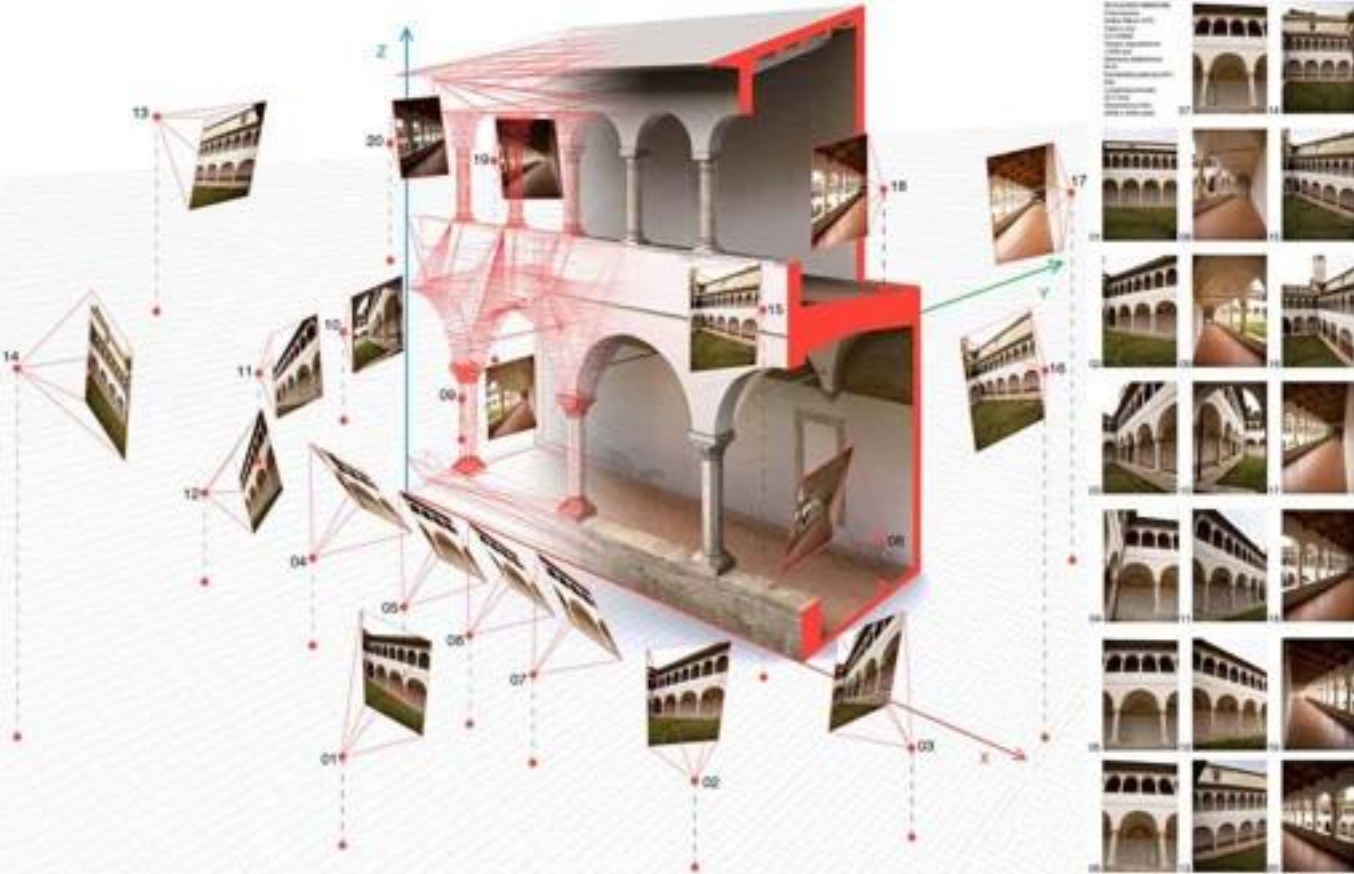
Case study:
Integration of missing volumes of the feet of the throneby Zeus from Solunto (Salinas Museum, Palermo).
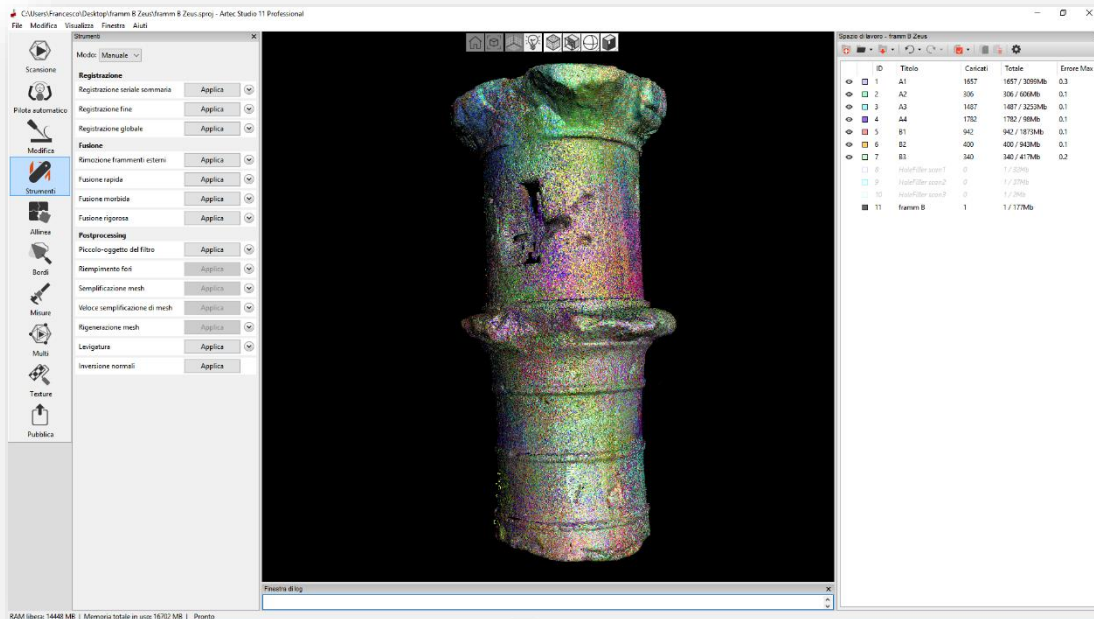
DIGITALISATION MODELS VIA 3D SCANNING

Artec™ Spider

Tecniche *range-based*
Fringes or pattern projection systems_structured light

Acquisition

Post Process

Data Visualization

...point clouds

...polygon mesh

...applied texture
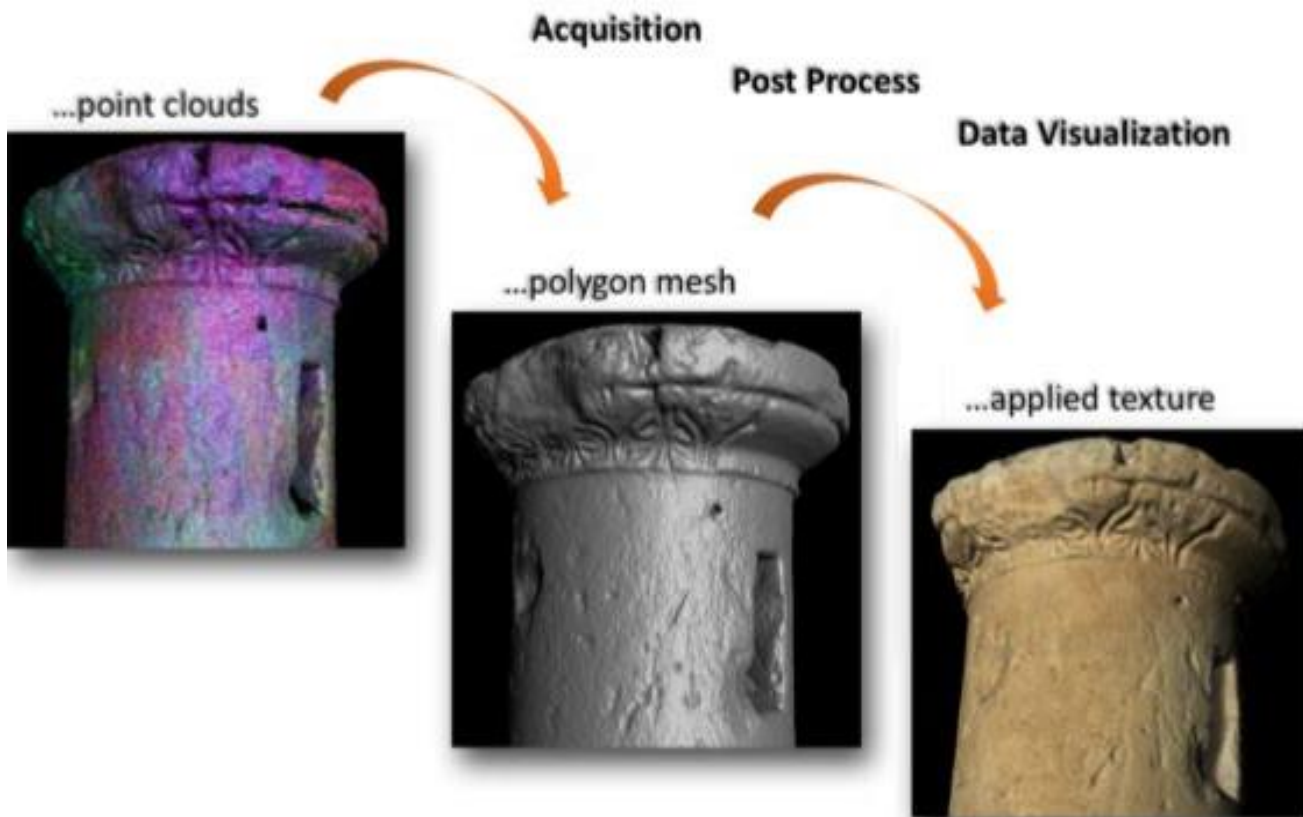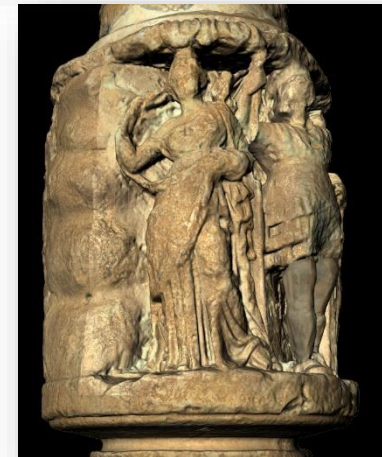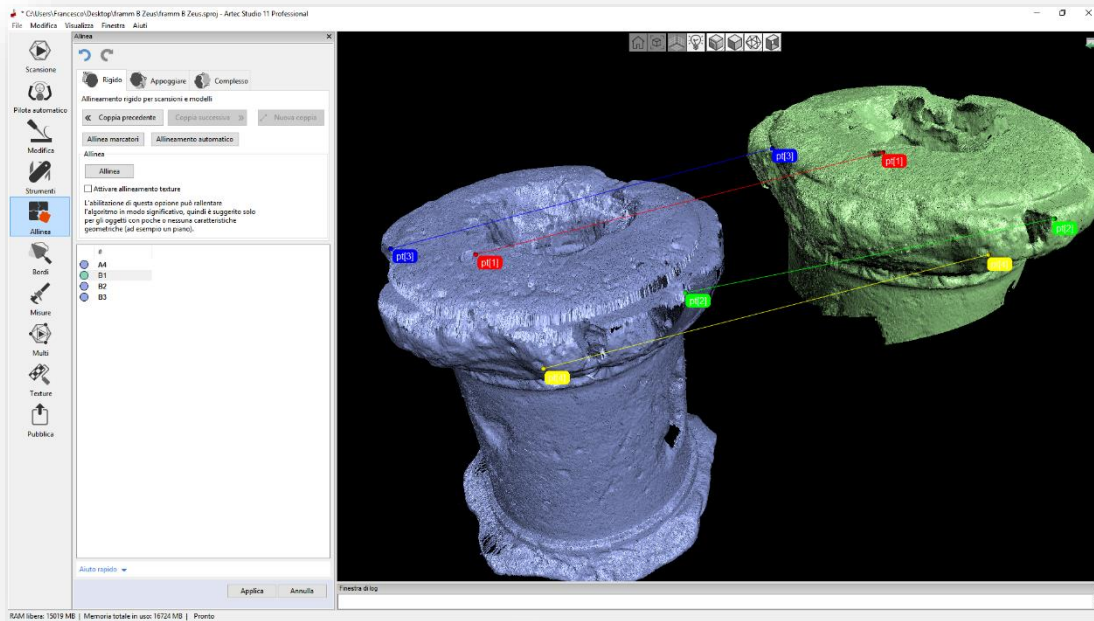
Data acquisition - alignment scanner frames
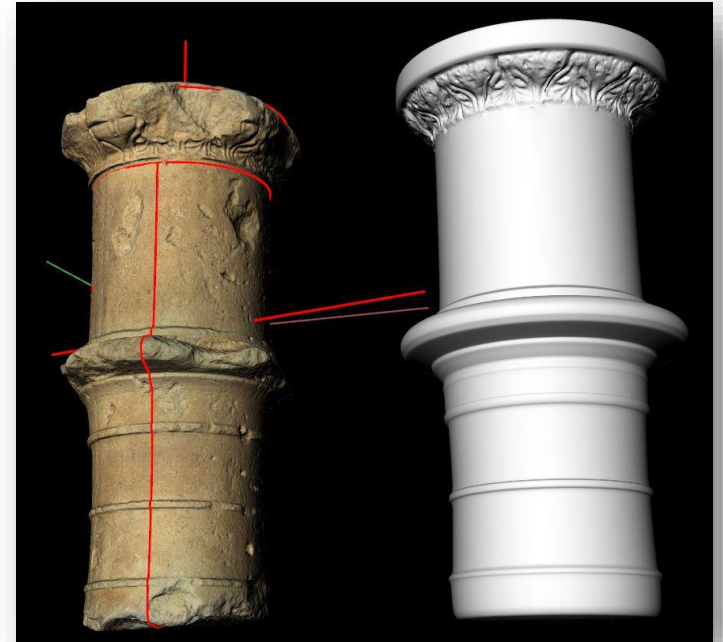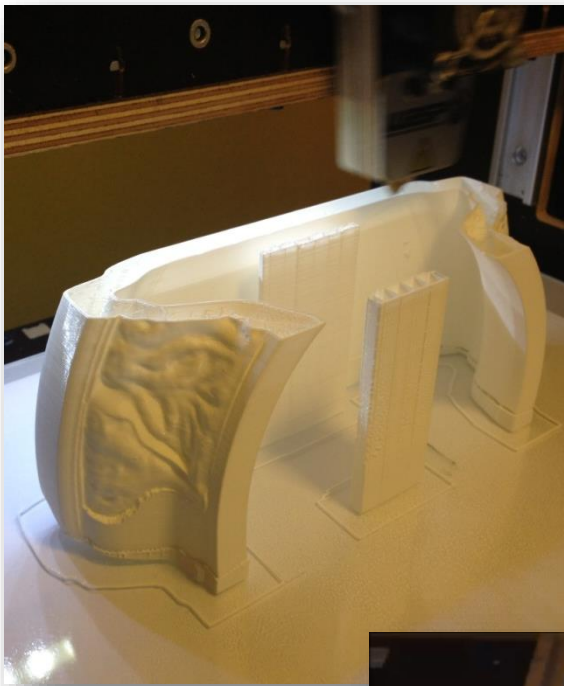
FABRICATION OF MISSING PARTS

CHECK CAD MODEL GEOMETRY
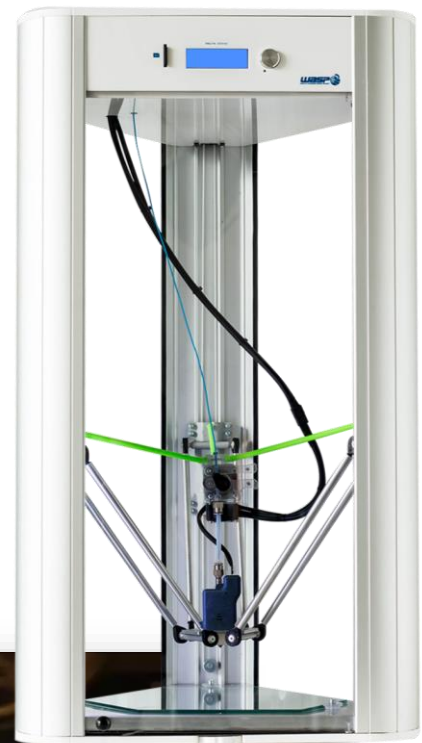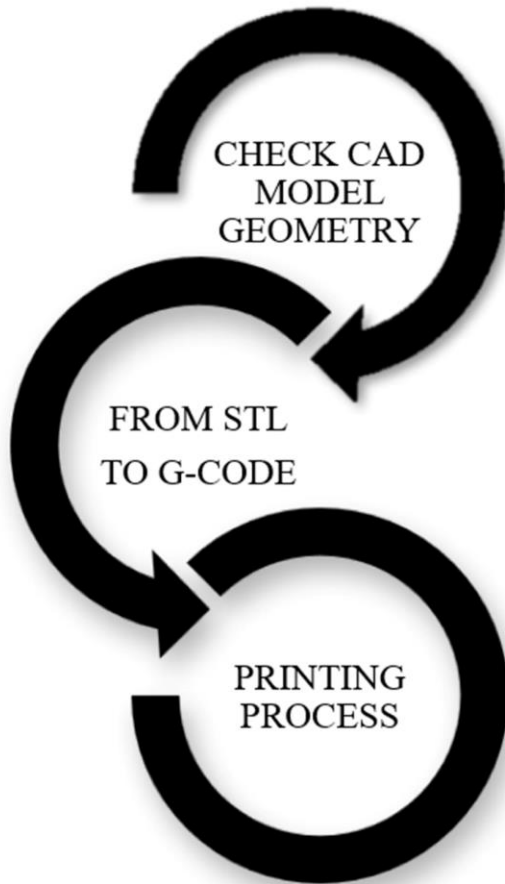
- Orientable mesh (correct normal vector orientation of polygonal faces);
- Corrections in edges (No self-intersections);
- Check of non-manifold geometries;
- Thickness sizing (Minimum wall-thickness);
- General sizing (build volume).

FROM STL TO G-CODE

- Settings import *parameters* within the printer software;
- Edit geometric properties: positioning and orientation;
- Resolution;
- Gravity and overhang
- Processing.

PRINTING PROCESS

- Preheating camera;
- Layer by layer printing;
- Precooling;
- Removing any support material.

IL CASO DI PIAZZA SETT'ANGELI
Integrated technologies_Laser Scanning; SFM; structured light

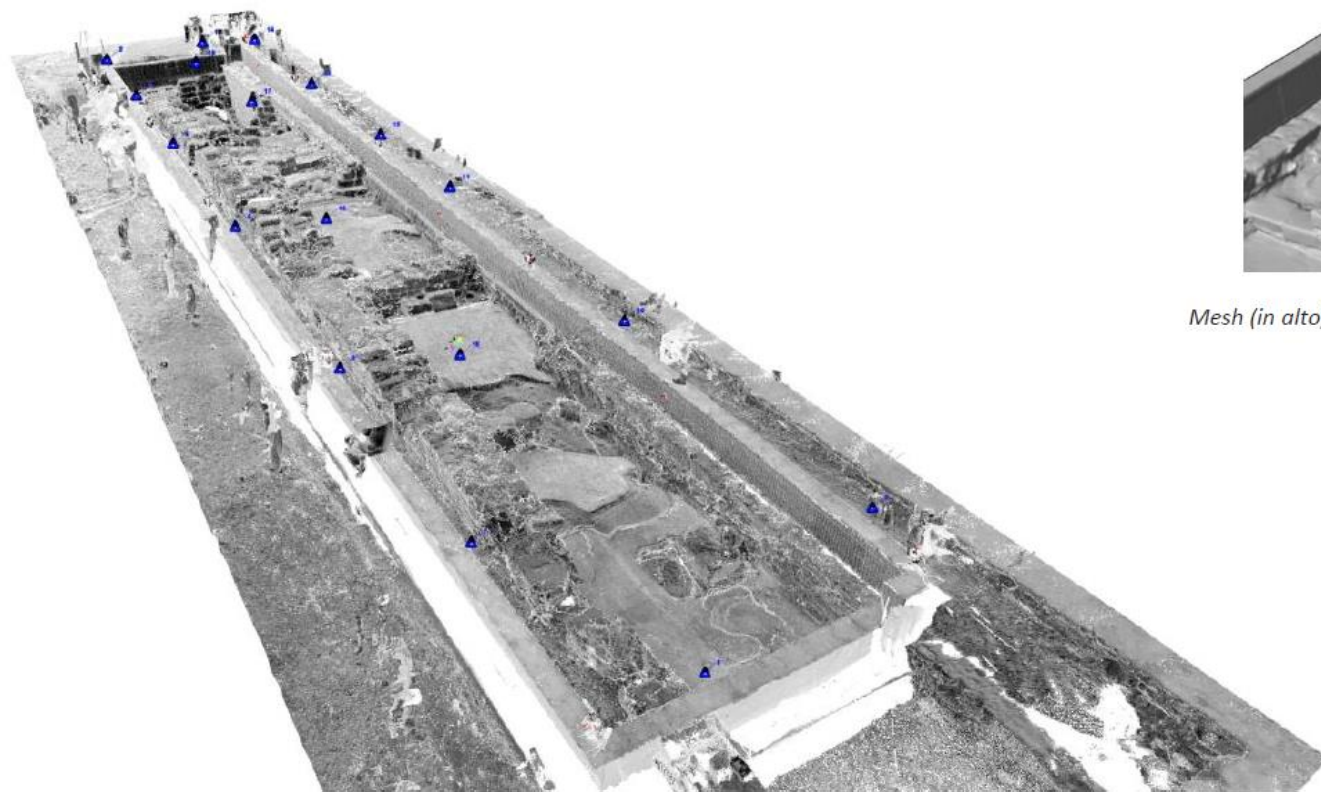*Mirco Cannella, Francesco Di Paola, Sergio Monteleone, Rosanna Sciortino*

Al fine di ottenere una ottimale documentazione di tutte le superfici orizzontali e in elevato della casa romana, sono state acquisite scansioni da 19 punti di stazione.


Mesh (in alto) e nuvola di punti (in basso) di un vano dell'edificio romano.

Vista assonometrica della nuvola di punti con indicazione dei punti di stazione.

In order to obtain an exhaustive documentation of the chromatic characteristics of the surfaces of the Roman house, photographs were taken with a high-resolution digital camera (21 Mp) from different positions from those of the parking points of the laser scanner.
At the end of the data acquisition phase, a total of 540 photographic images were acquired.

faces: 628,068 vertices: 315,163
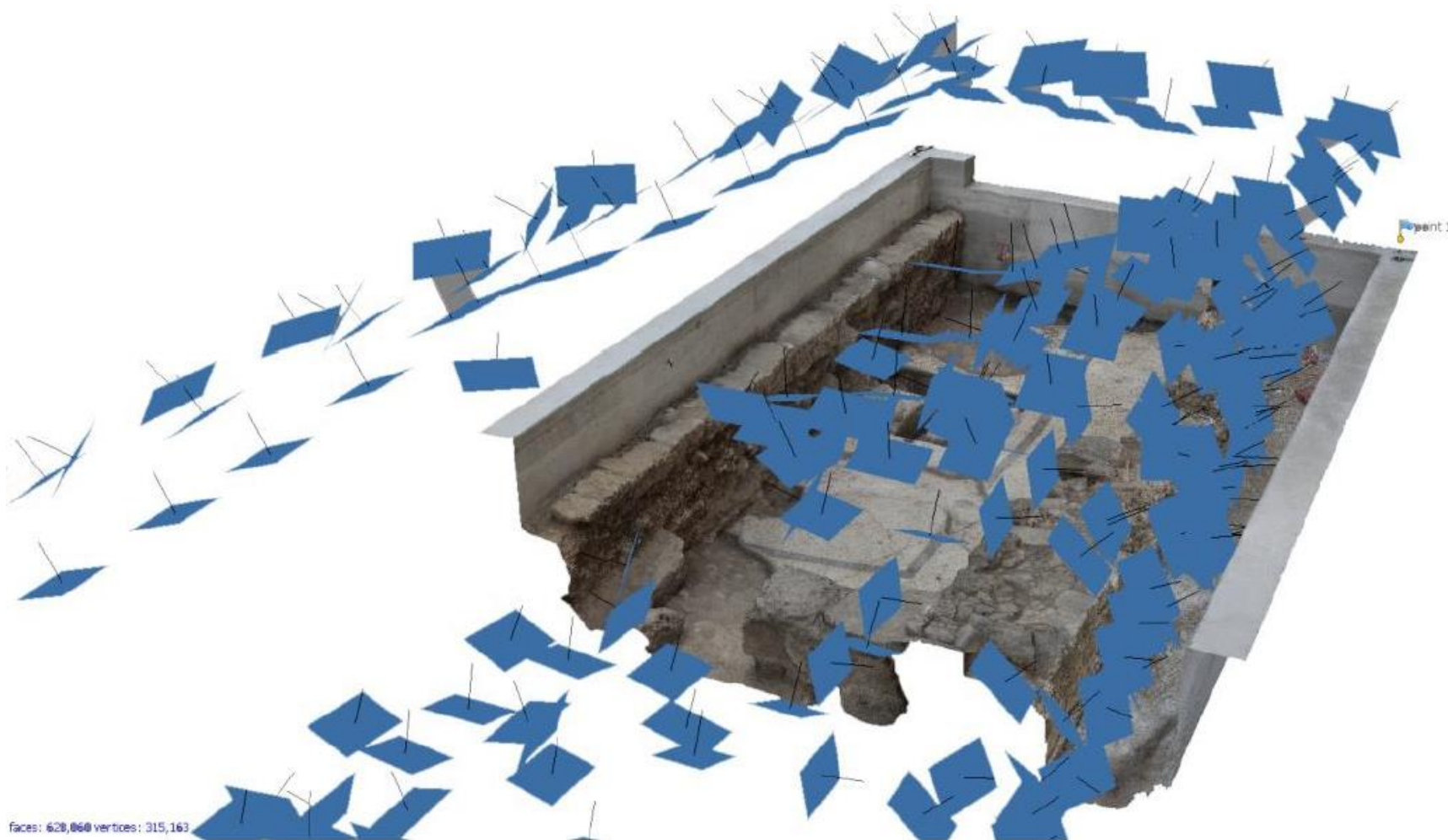
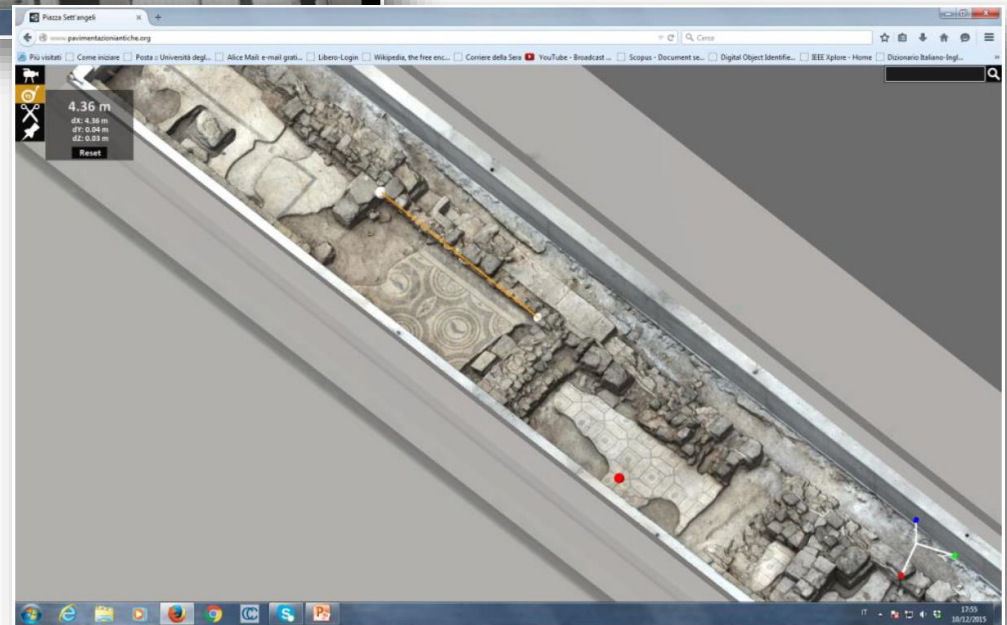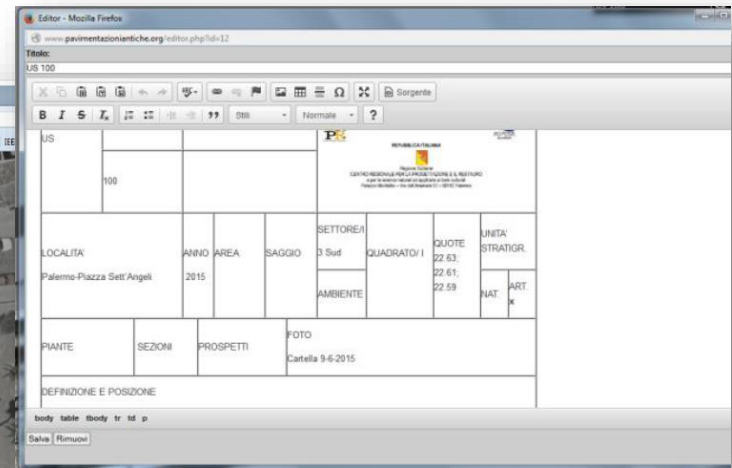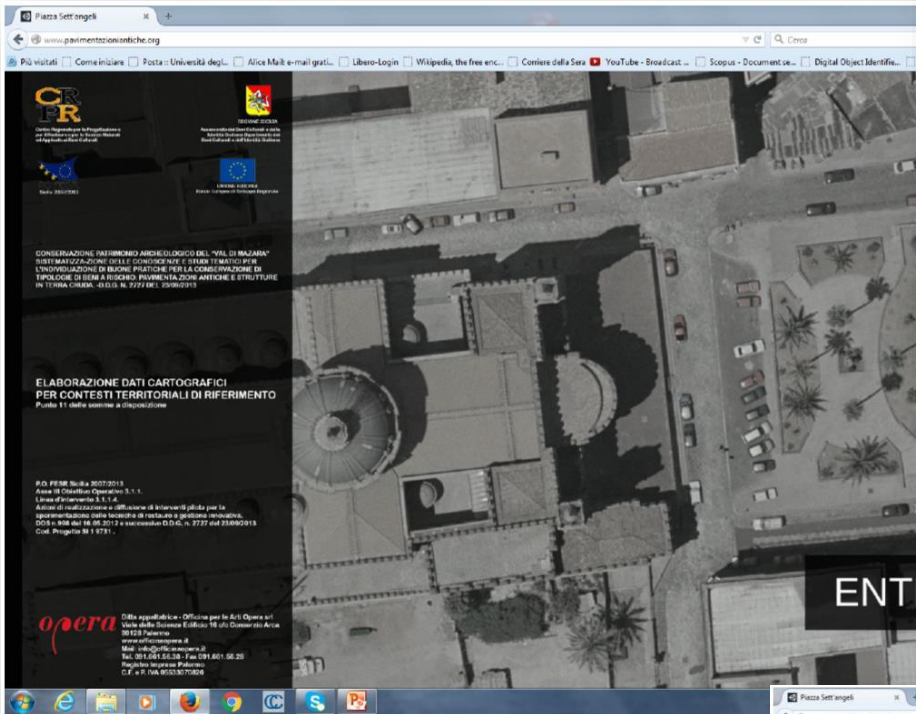*Orientamento delle prese fotografiche e creazione del modello mesh texturizzato.*

Creazione di Sezioni verticali con ortofoto delle superfici in proiezione.

The georeferenced data are dynamically available and associated with sheets compiled according to the conventional standards of the ICCD Mibact

THE SHAPE OF THE STUCCOS:THE CASE STUDY OF THE TILE "San Francesco veste il povero"

Oratorio di San Lorenzo, Palermo
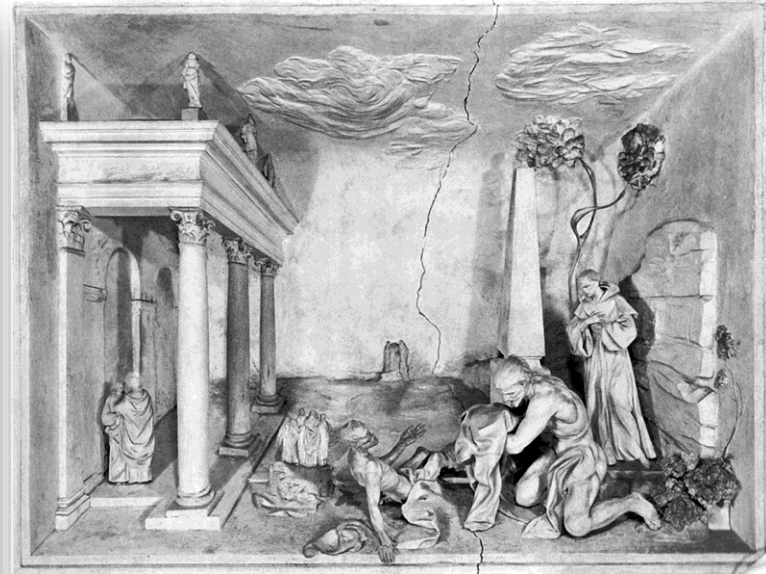
as it was...

as it is...

3D SCANNING Acquisizione 3D
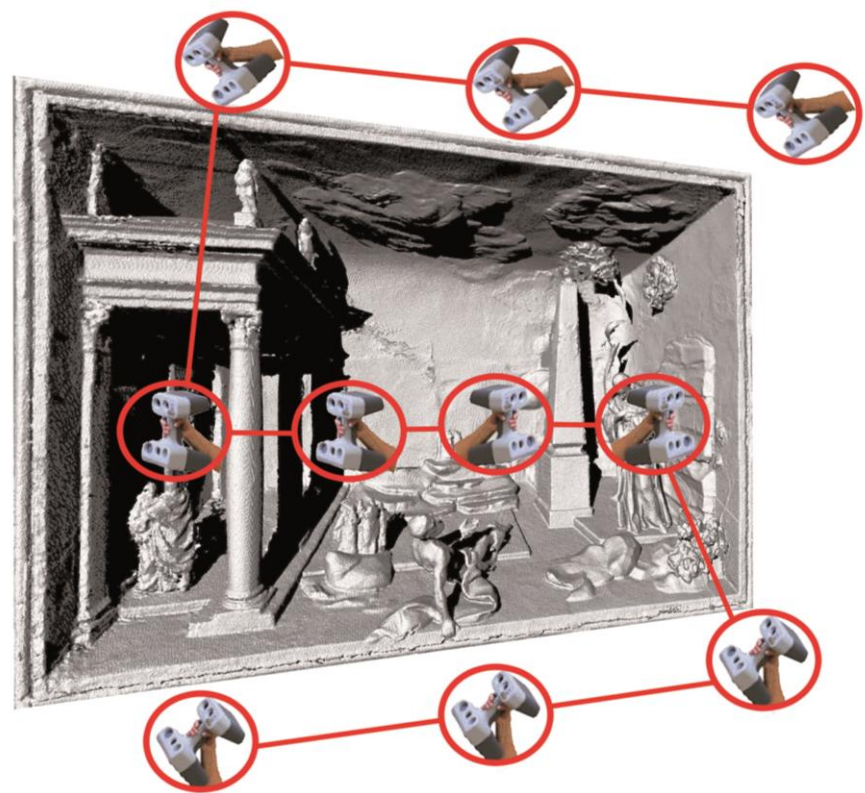
Elaborazione dati
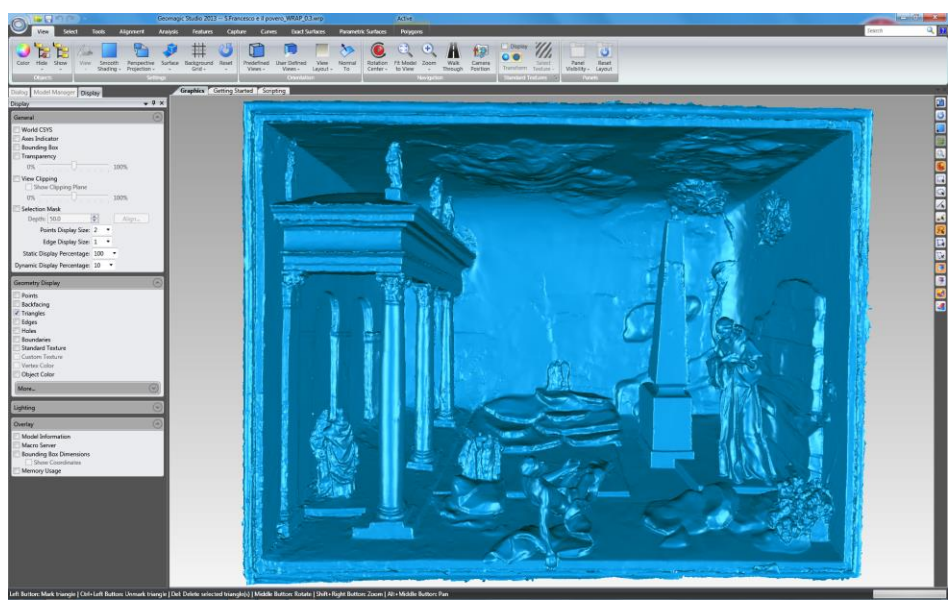
Analisi grafico-geometriche

Profondità reale

Profondità percepita
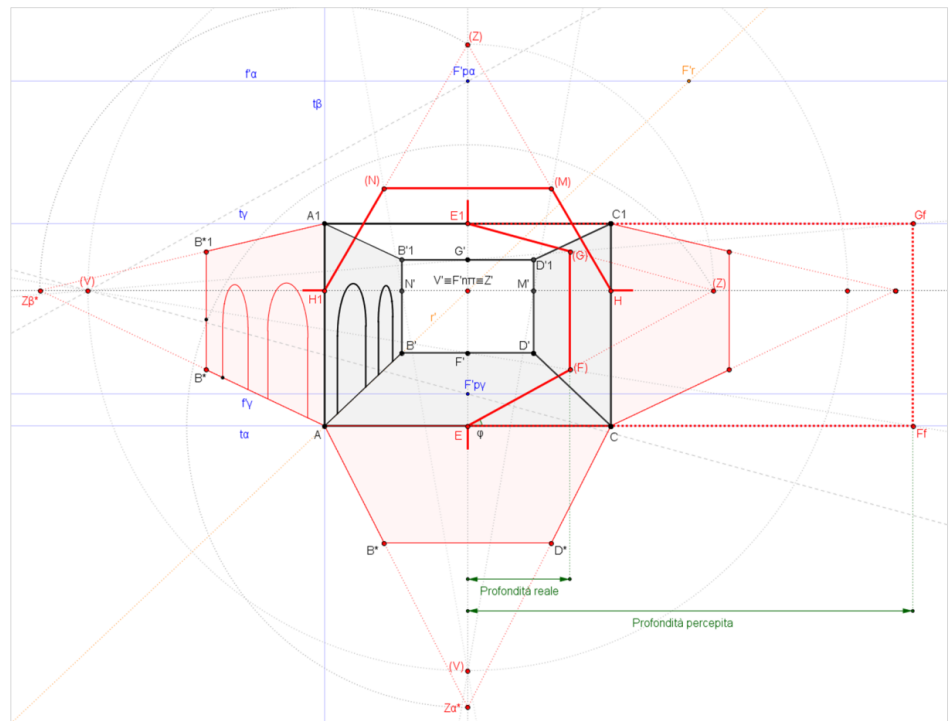
RICOSTRUZIONI VIRTUALI

Tecniche di 3D sculpting (ZBrush) a partire da primitive semplici
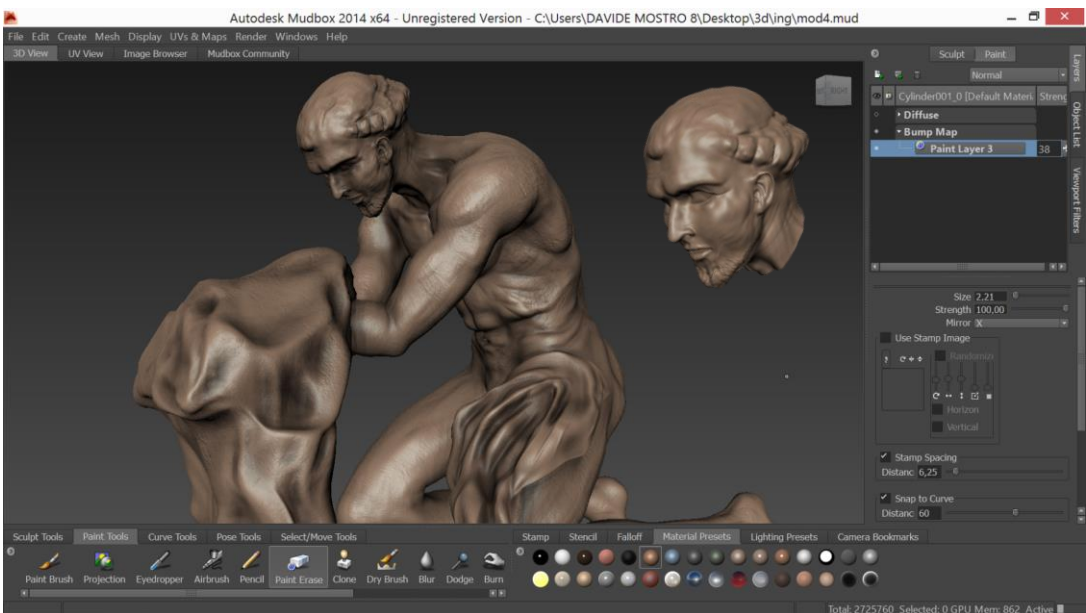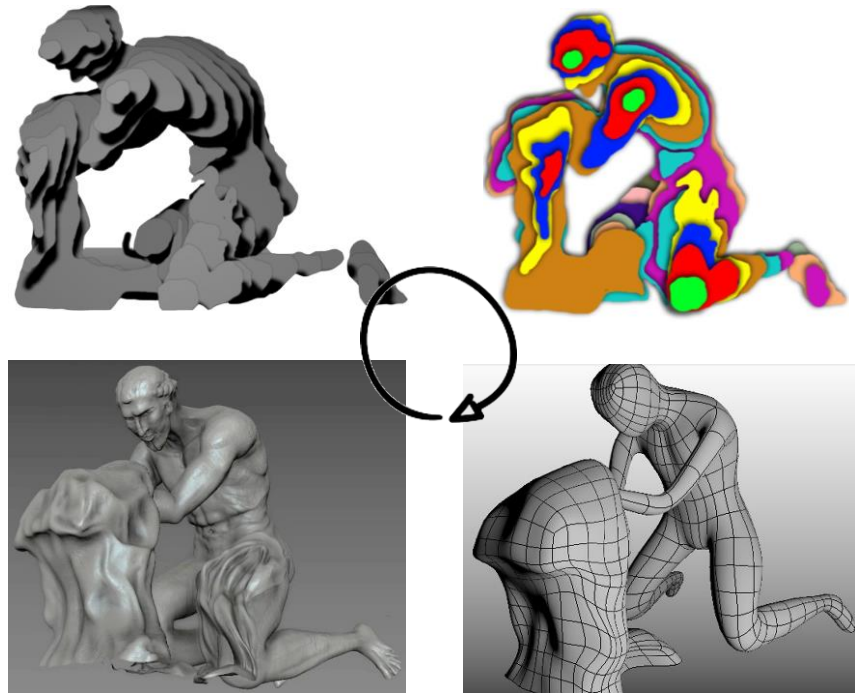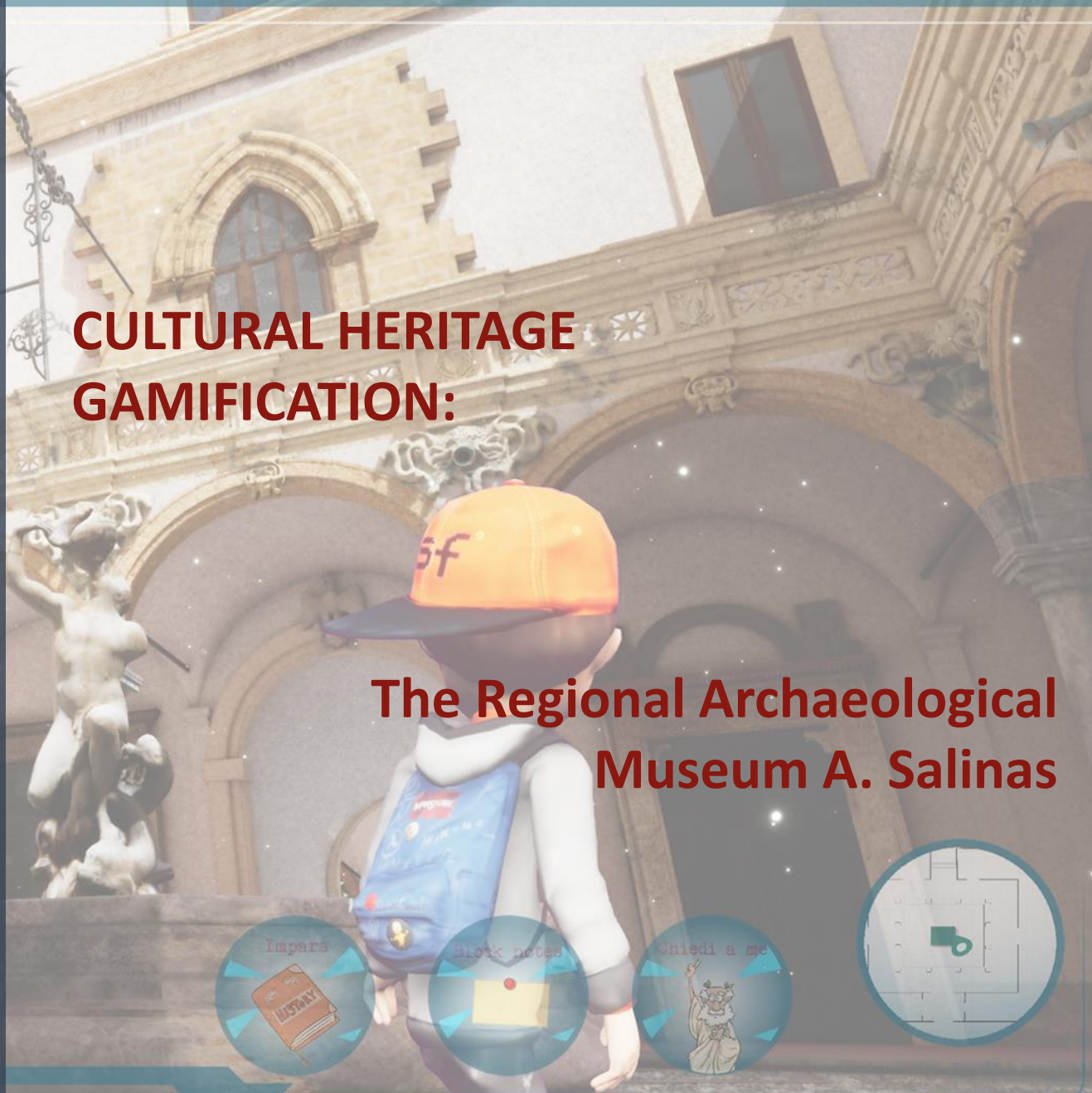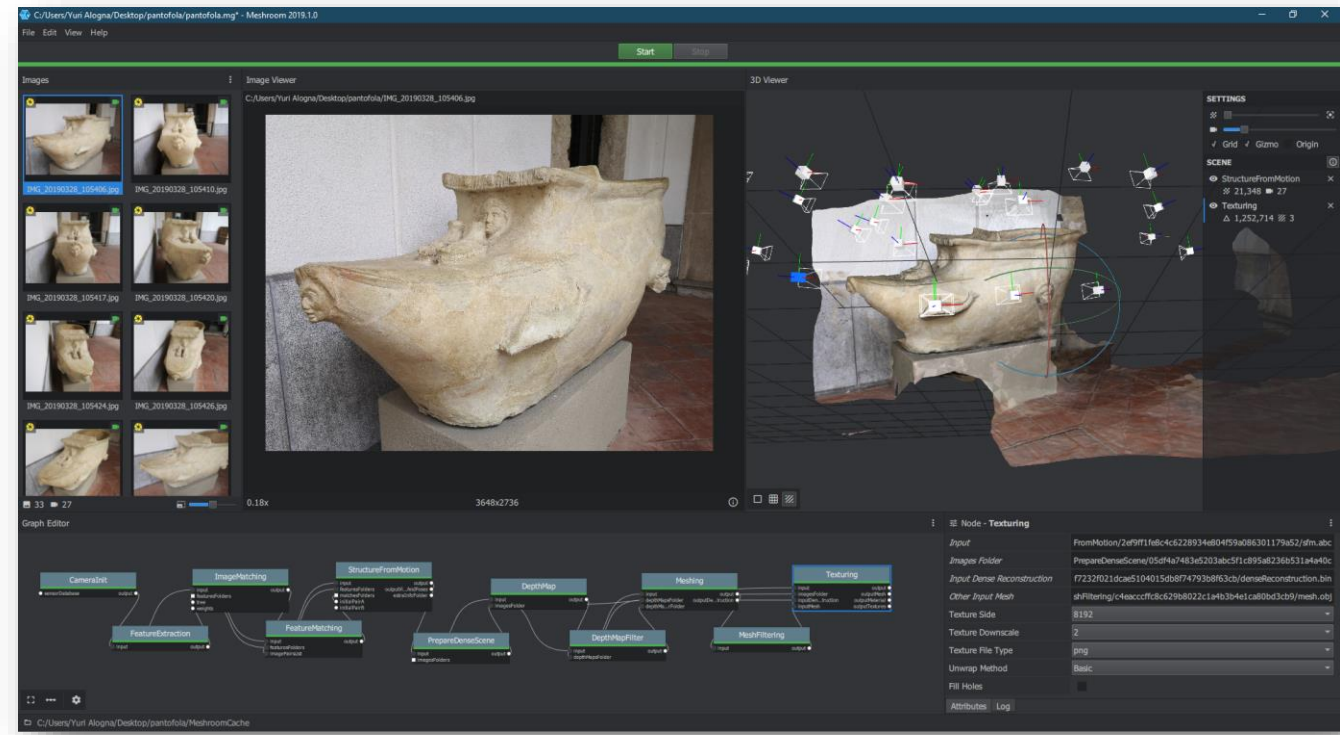
Instrumentation

Photogrammetric system, with mechanical telescopic rod, in carbon fibre, with remote control.
Gimbal 3-axis structure.
Sony 24 Mpx camera, 16-50mm lens.

1

2 Meshlab

3 Instant Mesh | Instant Mesh

4 Blender | Blender

Unreal Engine Editor

File Edit Window Help

Modes

Save Current | Source Control | Content | Marketplace | Settings | Blueprints | Cinematics | Build | Pause | Launch

Search Classes

Recently Placed
Basic
Lights
Cinematic
Visual Effects
Geometry
Volumes
All Classes

Empty Actor
Empty Character
Empty Pawn
Point Light
Player Start
Cube
Sphere
Cylinder
Cone
Plane
Box Trigger
Sphere Trigger

Total Treasures discovered 18 · 82% · Time Elapsed 12:35

Final chapter

Welcome Agent.
Congratulations agent, you have come this far, it means that you have been paying attention to the surrounding world, you have discovered treasures, and you have connected historical events correctly. Now the final moment has arrived...

In this room there are other items needed to complete your mission.

Now go, and use your intuition!

W
A S D
SPACE

World Outliner | **World Settings**

Search Details

Precompute Visibility
Precompute Visibil
Game Mode
GameMode Overri None
Selected GameMo
Lightmass
Lightmass Settings
World
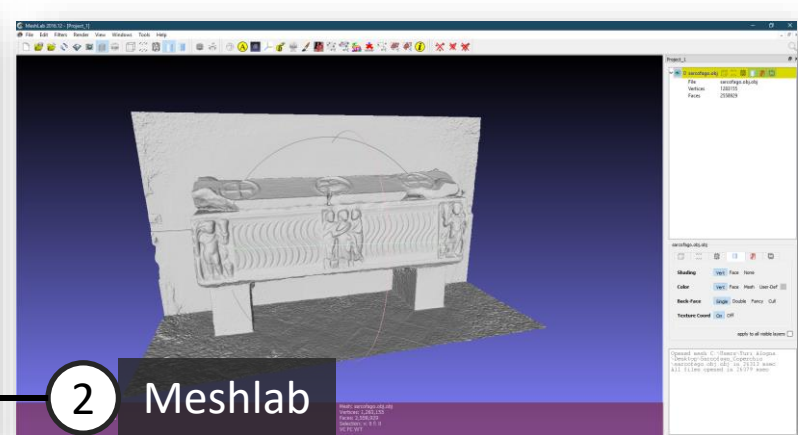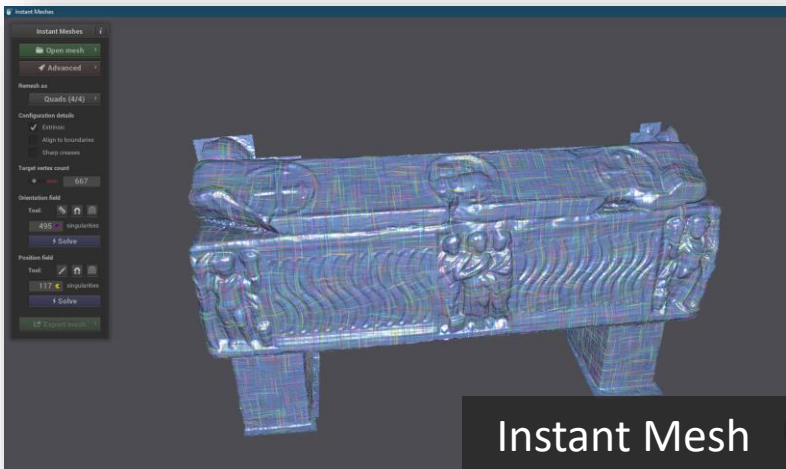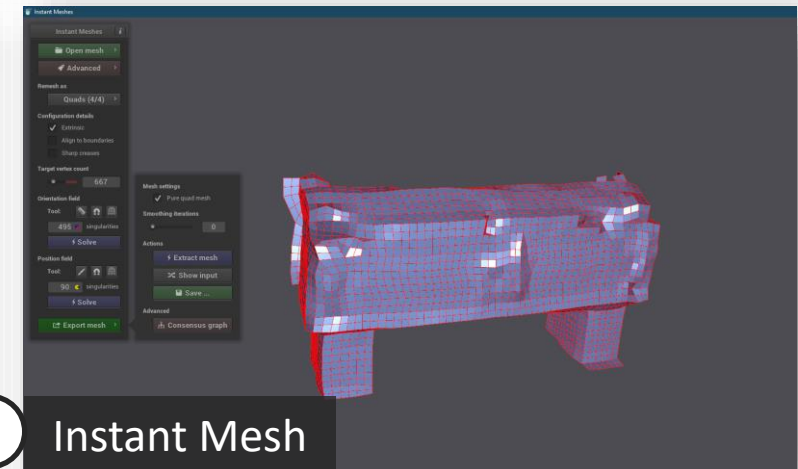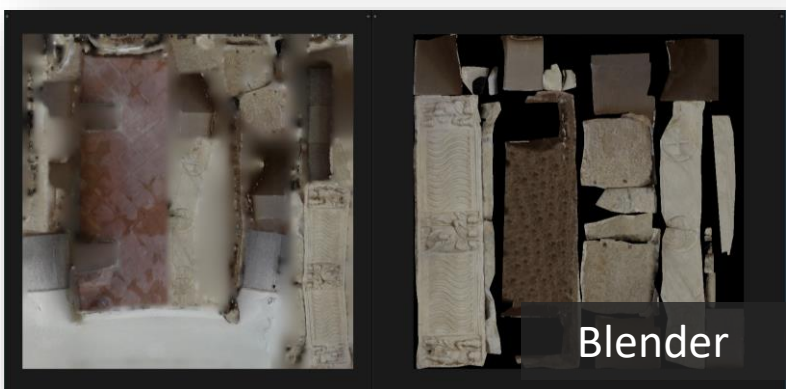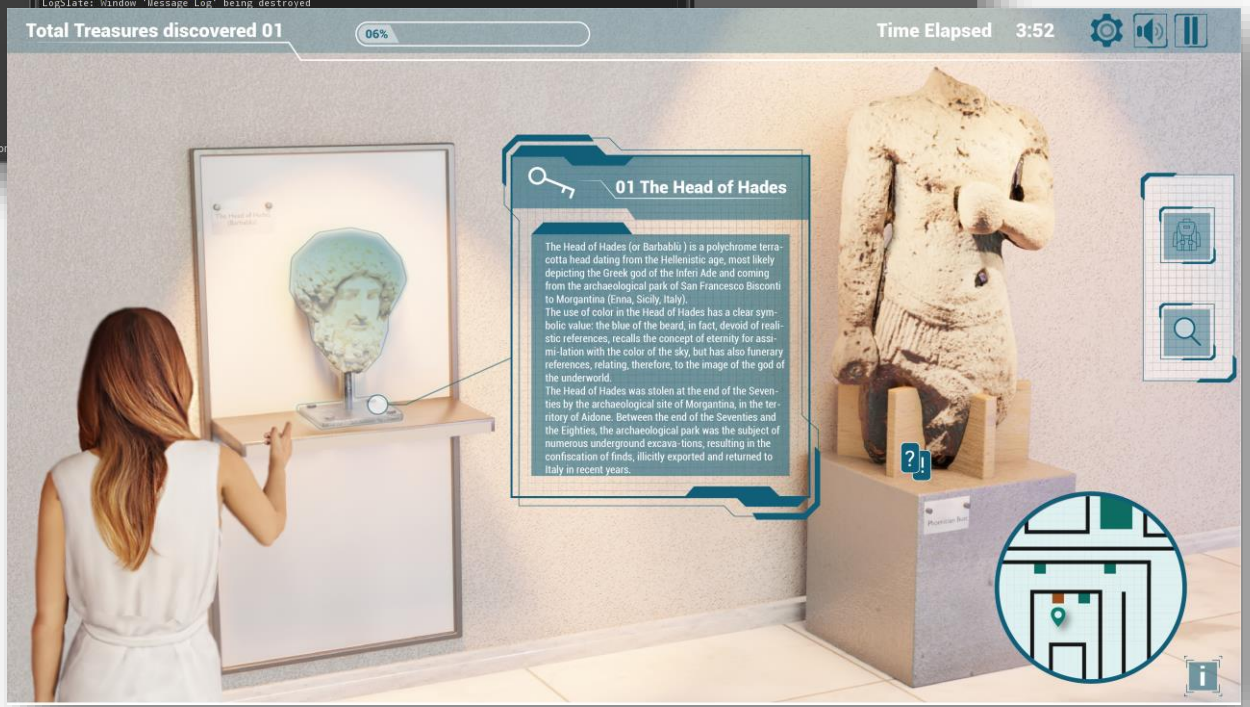Enable World Comp
Use Client Side Lev
Kill Z -1048575.0
Physics
Override World Gra
Global Gravity Z 0.0
Broadphase
Override Default Br
Broadphase Setting
VR

Details
Select an object to view details.

Content Browser

Add New | Import | Save All | Content ▸ testing_environment ▸ 01_room

Search Folders

Content
testing_environment
01_room

modello_3_low_ C
modello_3_low_ N

2 items (2 selected) View Option

Output Log

Filters ▾ | Search Log

LogFbx: FBX Scene Loaded Succesfully
LogSlate: Window 'FBX Import Options' being destroyed
LogMaterial: Display: Missing cached shader map for material Material_001, compiling.
LogStaticMesh: Building static mesh character_female...
LogStaticMesh: Built static mesh [0.05s] /Game/testing_environment/character_female.character_female
FBXImport: Warning: No smoothing group information was found in this FBX scene. Please make sure to enable be inferred while importing.
LogSlate: Window 'Message Log' being destroyed

Total Treasures discovered 01 · 06% · Time Elapsed 3:52

01 The Head of Hades

The Head of Hades (or Barbablù) is a polychrome terracotta head dating from the Hellenistic age, most likely depicting the Greek god of the Inferi Ade and coming from the archaeological park of San Francesco Bisconti to Morgantina (Enna, Sicily, Italy).
The use of color in the Head of Hades has a clear symbolic value: the blue of the beard, in fact, devoid of realistic references, recalls the concept of eternity for assimi-lation with the color of the sky, but has also funerary references, relating, therefore, to the image of the god of the underworld.
The Head of Hades was stolen at the end of the Seventies by the archaeological site of Morgantina, in the territory of Aidone. Between the end of the Seventies and the Eighties, the archaeological park was the subject of numerous underground exca-vations, resulting in the confiscation of finds, illicitly exported and returned to Italy in recent years.

Designing Game Stages
   and Learning by
   Doing Strategies

THANK YOU FOR YOUR ATTENTION

Ing. Francesco Di Paola
Ricercatore in Disegno S.S.D. ICAR/17
Dipartimento di Architettura (DARCH)
Università degli Studi di Palermo
francesco.dipaola@unipa.it
389.4324760

UNIVERSITÀ DEGLI STUDI DI PALERMO

Dipartimento di Architettura

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