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4th Euro-Mediterranean Conference & Exhibition 2020

A Web-Based Platform for Promoting Cultural Tourism: The Case Study of Meteora, Greece

Charalabos Ioannidis, Sofia Soile, Argyro-Maria Boutsi and Styliani Verykokou

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Presentation Outline

Motivation

The Project

Data collection & 3D modelling

The Platform

Conclusions & Future Work

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Motivation

ONLINE PUBLICATION

1. Conservation of cultural heritage assets:

digital 3D replica for diagnosis & monitoring, restoration, risk assessment etc.

2. Researchers surveys and collaboration:

remote access, real-time co-operation, content updating & outward-looking policies

3. Promotion of cultural tourism:

- user-friendly flow of heritage information to the visitor through interactive & engaging tools
- high-resolution and geometrically accurate 3D models
- scalable, contextual and data enriched visualization

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Motivation

CURRENT STATE OF CH REPOSITORIES

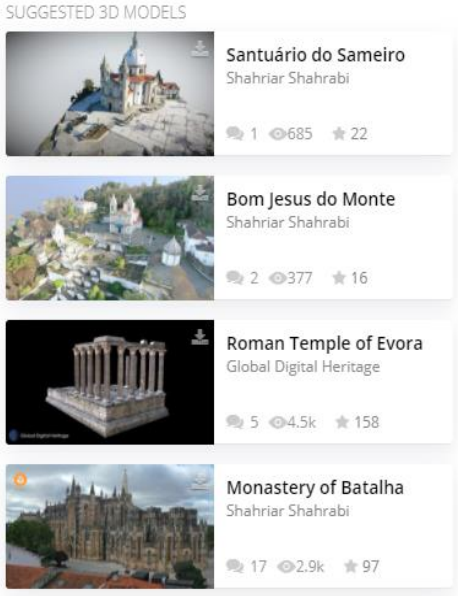
3D Libraries: CYARK Google Arts & Culture

visual quality | interactivity | data interoperability | information systems

Organizations, museums & research projects: Global Digital Heritage The British Museum ZAMANI PROJECT

Santuário do Sameiro
3D Model

Sketchfab



3DHOP

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Common services:

- free exploration of the 3D scene (move, rotate, zoom)
- highlighted or clickable points of interest with aside information
- multimedia integration with a static role
- format-based separation of heterogeneous data

Inadequate navigation type for large-scale monuments & complex geometry

Lack of spatial correlation of 2D – 3D data & intuitive knowledge transfer

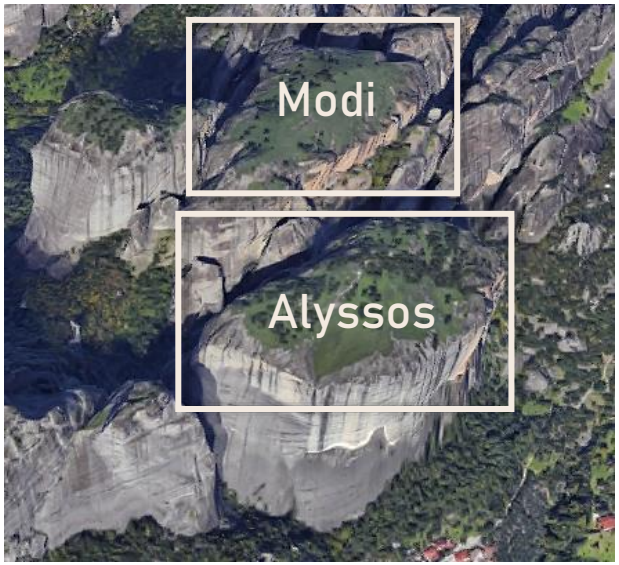
The Project

SCOPE - OBJECTIVES

Information System for Multi-Level Documentation of Religious Sites and Historic Complexes: METEORA project

- Multidisciplinary academic project involving: Engineering, Architecture, Computer Science, History and Geography of the Church

- Aim: Creation of a web-based platform for the management, visualization and dissemination of the products of multi-level documentation of archaeological sites



- Main case study: Part of the archaeological/holy site of Meteora, Greece ('Modi' and 'Alyssos' rocks)

- Multi-source content: 3D spatial data + 4D representation (LoD) + non-spatial information

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The Project

SCOPE - OBJECTIVES

Objectives:

- Innovative techniques for data collection, data processing and 3D modelling, lying in the fields of photogrammetry and computer vision
- Web-based platform that comprises:
  i. a multi-resolution 4D visualization system
  ii. user-friendly front-end interface
  iii. relational database with administration system
- Various tools for interaction with the 3D scene & data retrieval services
- Different user categories with personalized content & services differentiation
- Mobile Augmented Reality app

Criteria for CH Tourism:

- High-quality visualization
- Logical & spatial correlation of data of heterogeneous origin, format and field of interest
- Specialized services for various categories of users

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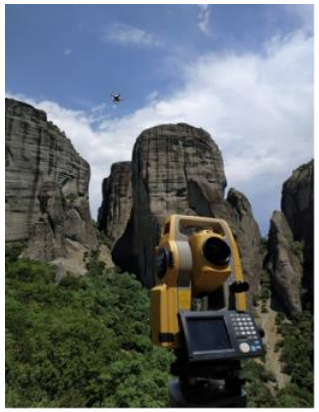
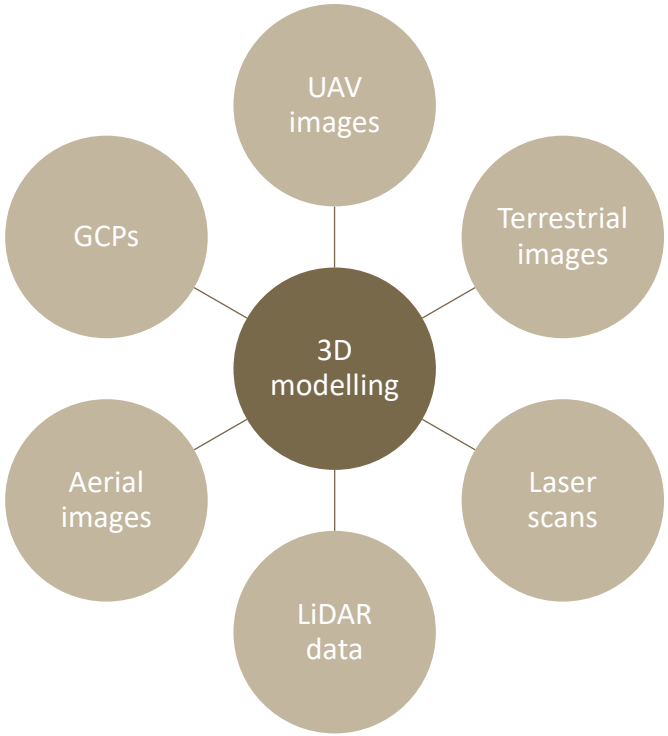
Data collection

SPATIAL DATA

Area of 10 km² of significant variations in altitude, dense vegetation and a 6 km² archaeological site with a big number of landmarks





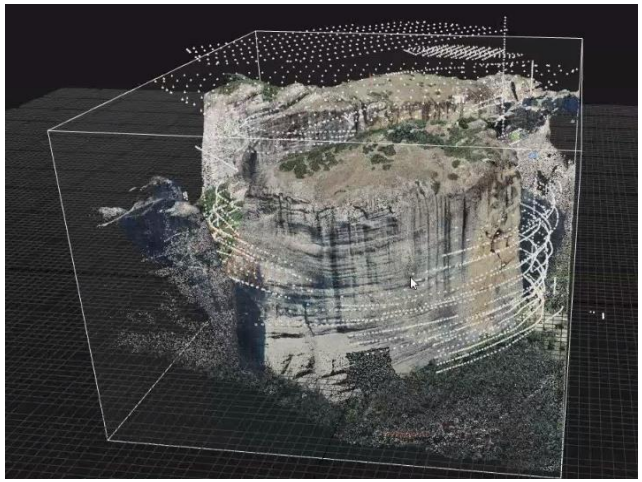
Multi-source documentation:

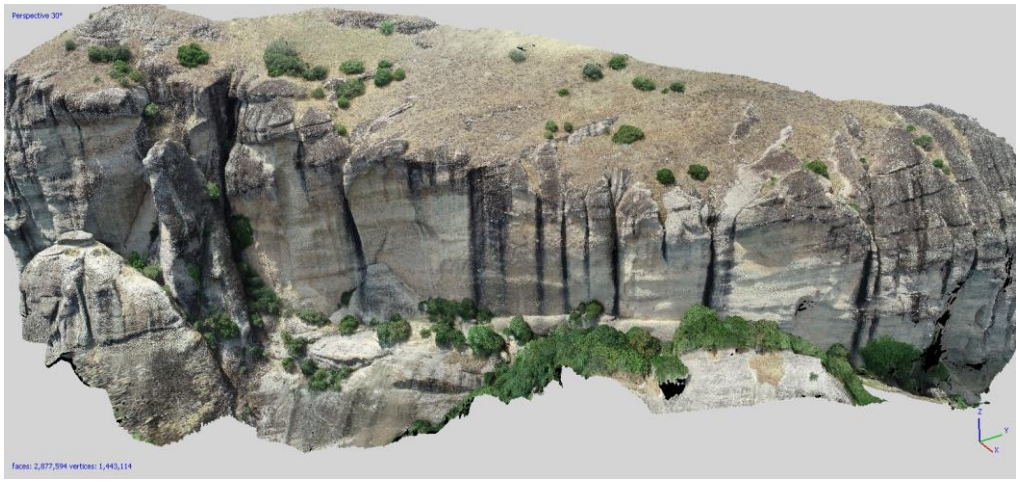
- Vertical & oblique aerial images from manned & unmanned aerial vehicles
- Airborne laser scanning (LiDAR)
- GCPs through RTK GPS
- Terrestrial images

3D modelling

Image-based creation of 3D models:

- Images orientation through Structure from Motion (SfM)
- Generation of dense points clouds
- Creation of 3D surface through Multi-view Stereo & texture mapping





Multi-resolution format: Geometry division with various LoDs

fast start-up time | minimized network load | maintenance of visual quality

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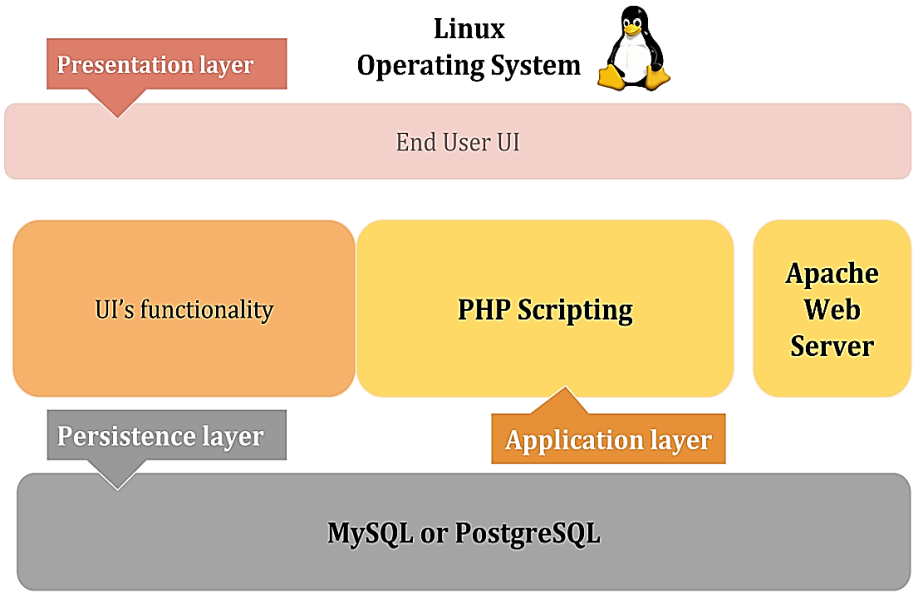
The Platform

SYSTEM ARCHITECTURE

LAMP stack: Linux – Apache web server – MySQL – PHP

open-source with transparency & compatibility



3-Tier Architecture:

Presentation layer

2D/3D/4D visualization

Search & retrieve services

Interaction tools

Application layer

Data transfer

Control of client/server communication

Persistence layer

Storage, organization & management of data

The Platform

TECHNOLOGIES

3D/4D Visualization system:

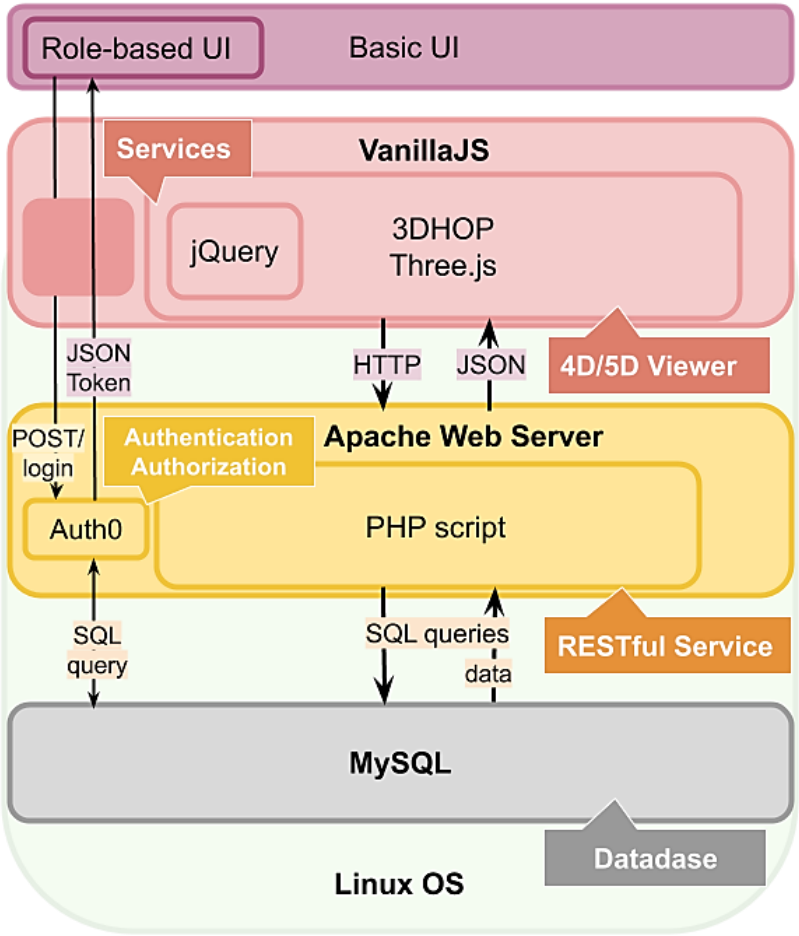
3DHOP framework & Three.js library

Control access & content management:

RESTful service on Apache based on PHP scripting

Storage and indexing of structure data:

MySQL DBMS in Linux OS



The Platform

PRESENTATION LAYER

Web Development (HTML, CSS & JavaScript) – jQuery library & Bootstrap framework

Open-source visualization tools:

3DHOP (3D Heritage Online Presenter	Three.js library	WebGL API
multiresolution rendering scheme	advanced computer graphics with GPU acceleration	
multi-thread JavaScript structure with exposed functions for the control of the 3D viewer & the HTML page	wide-range of 3D loaders	
default toolset with interactive functionalities like camera & lighting control, measurement suite etc.	scene-graph structure for customized 3D scene definition	

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APPLICATION / PERSISTENCE LAYER

Variety of non-spatial data conserving the historical, religious, cultural, architectural and geopolitical aspects of the area of interest: Images, video, text & metadata

Database management system (DBMS):

- storage, indexing & management of unstructured data
- support the CRUD functions of the REST service

→ MySQL, phpMyAdmin

RESTful infrastructure:

- specifying/analyzing the actions to be performed
- user authorization based on credentials (username & password)
- data authentication & license (token) retrieval

→ PHP, AJAX

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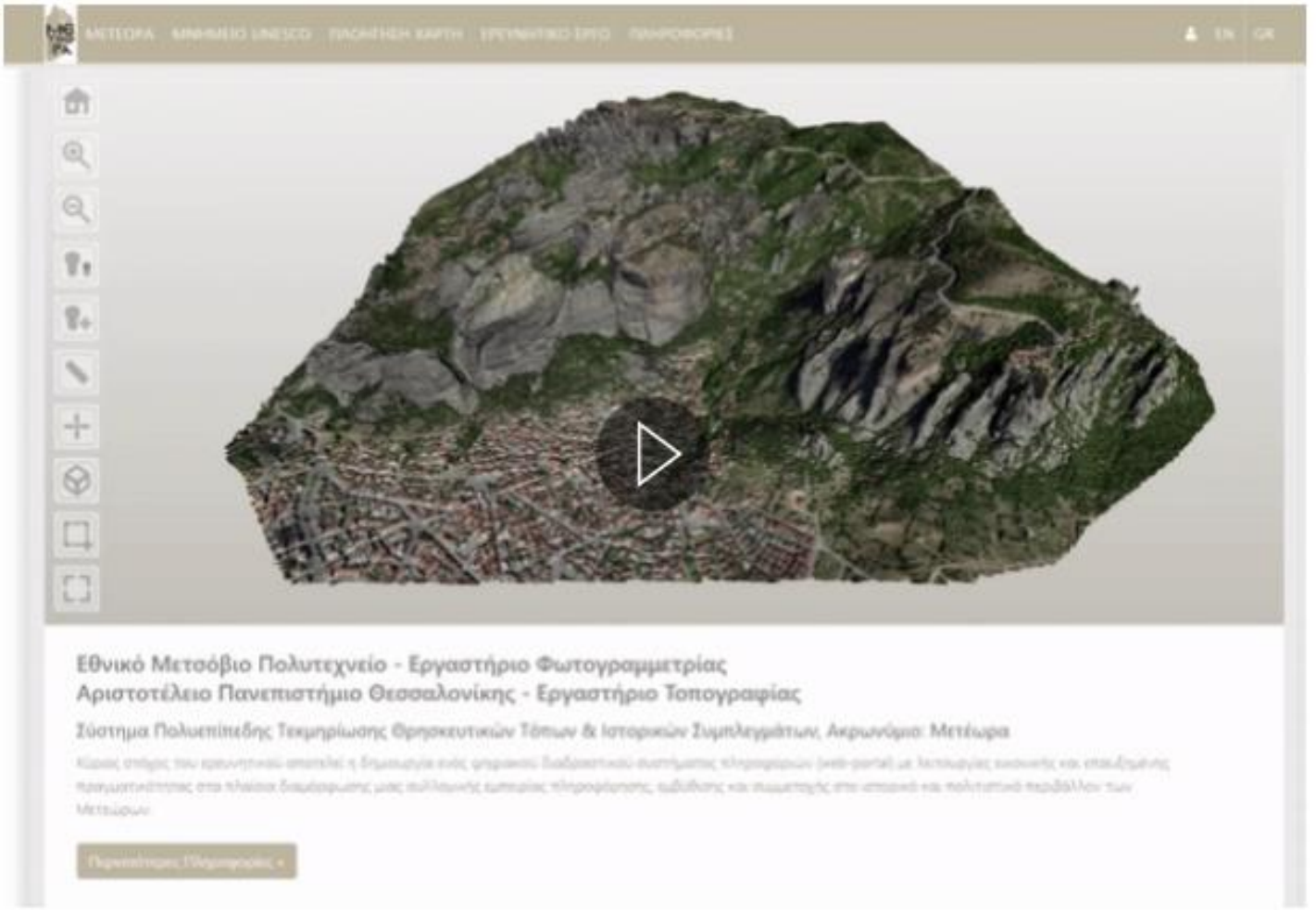
GRAPHICS USER INTERFACE

Prototype available online:

http://meteora.topo.auth.gr/3d-map.php



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The Platform

USERS CATEGORIES

Geospatial engineers

Archeologists / Architects / Conservators

Historians / Philologists / Theologians / Priests

Entrepreneurs

Cultural Heritage authorities

TOURISTS

- 3D Navigation
- Hotspots
- Search & Retrive
- Tracking & Spots discovery
- 2D Map Spots Discovery
- Multimodal content
- AR experience

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3D NAVIGATION

Virtual tours in the 3D models:

- free exploration with the trackball
- animated transitions to selected by the user landmarks or toponyms

- narrative automatic navigation by sequential seamless transitions to the landmarks or toponyms

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HOTSPOTS

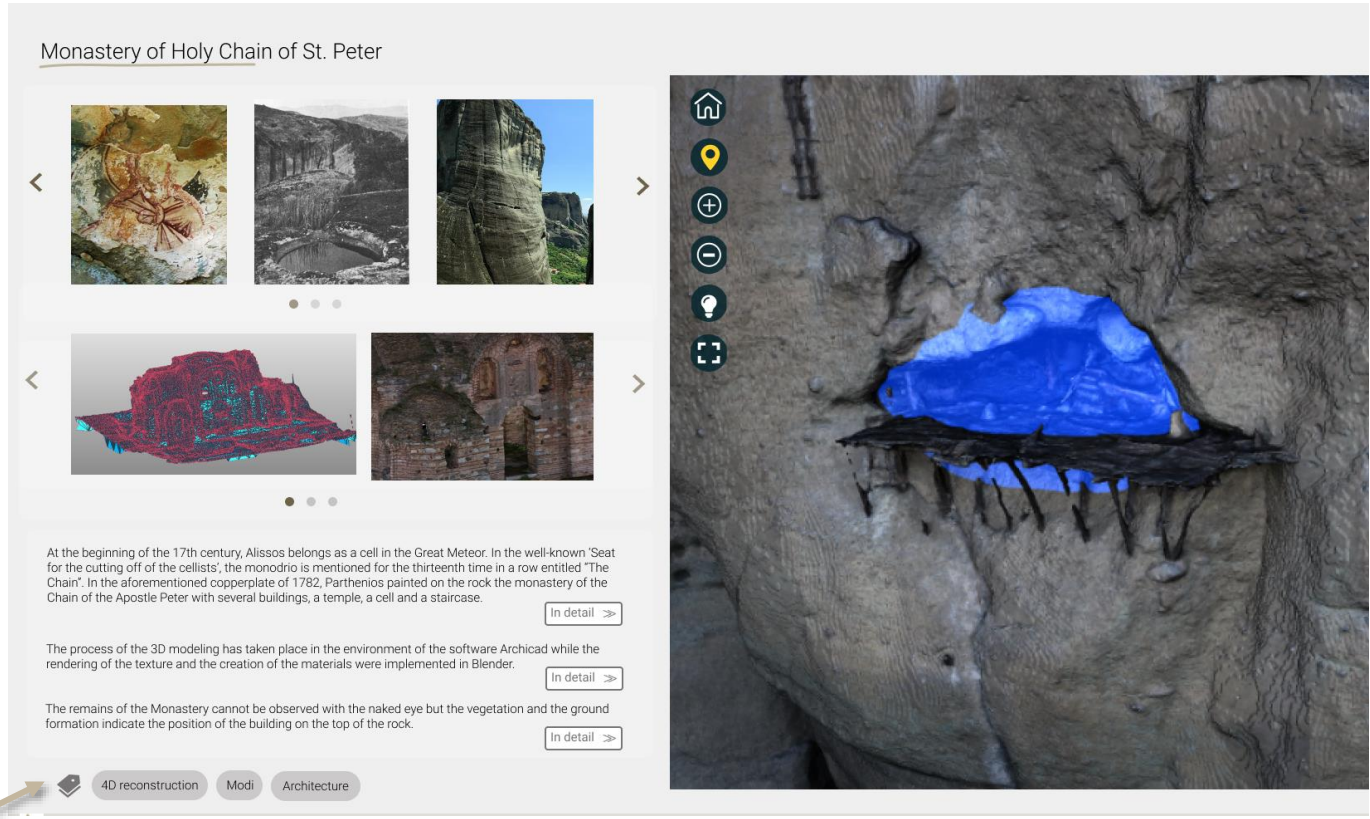
Hotspots: Clickable geometry on top of landmarks on the surface of the 3D models

On user click:

i. smooth animation to frame the spot

ii. access to relative image & video collections & contextual information

Different types of information based on user's area of interest



Tags for quick redirection

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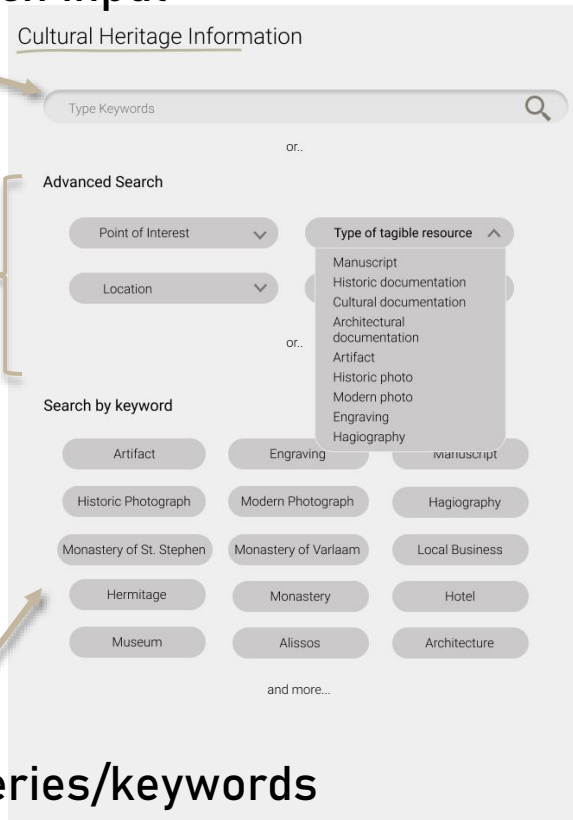
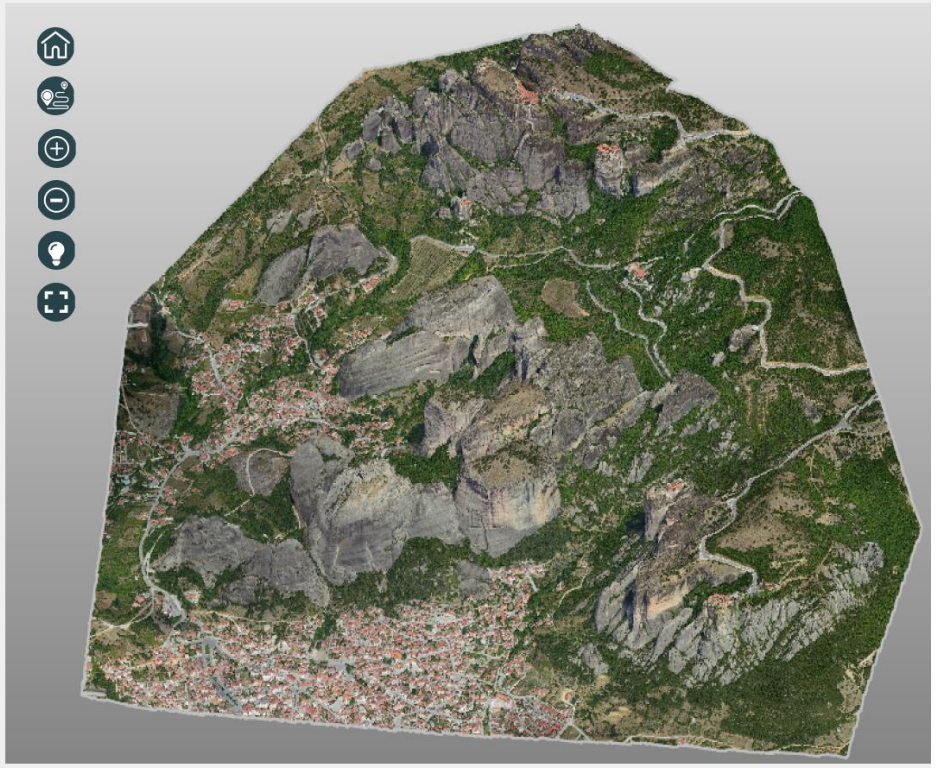
SEARCH & RETRIEVE

Search & Retrieve: Three types of search bars for content filtering and quick access

Custom search input

Filtering by POI, type of resource, location or format





Specific queries/keywords

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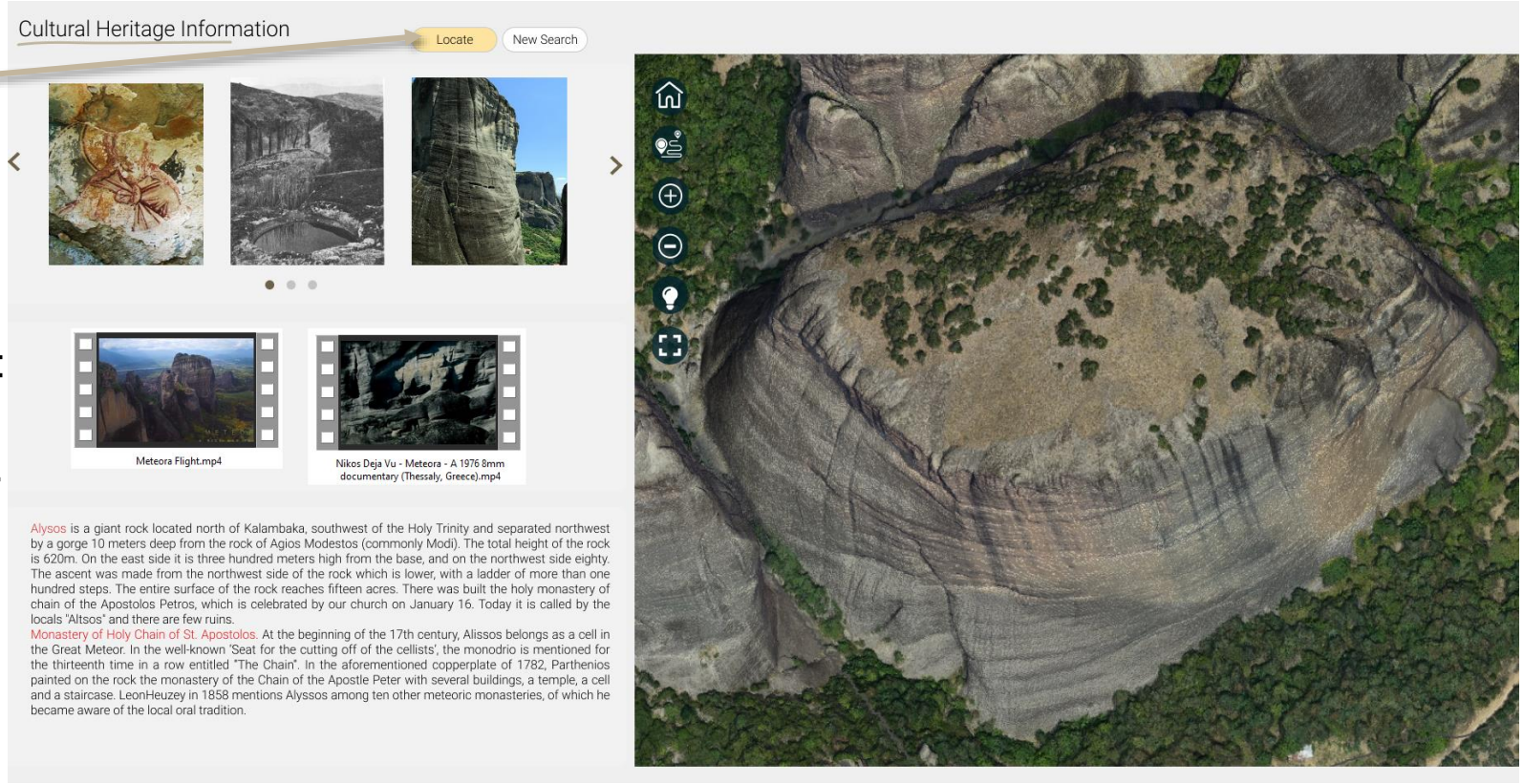
SEARCH & RETRIEVE

Search & Retrieve: Database parsing and displaying of all relative data in categories

Location feature:

Animate the camera to frame the selected spot if it is part of the 3D model



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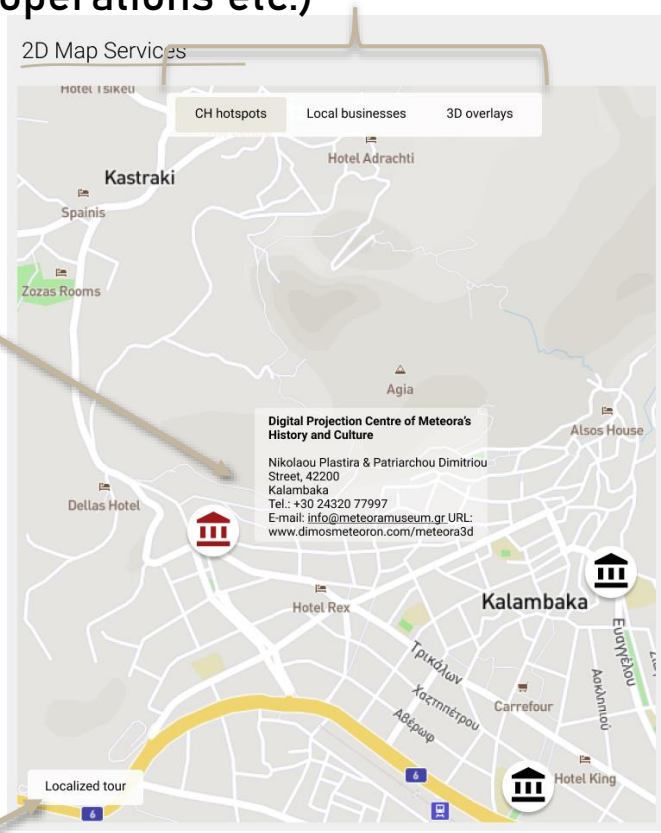
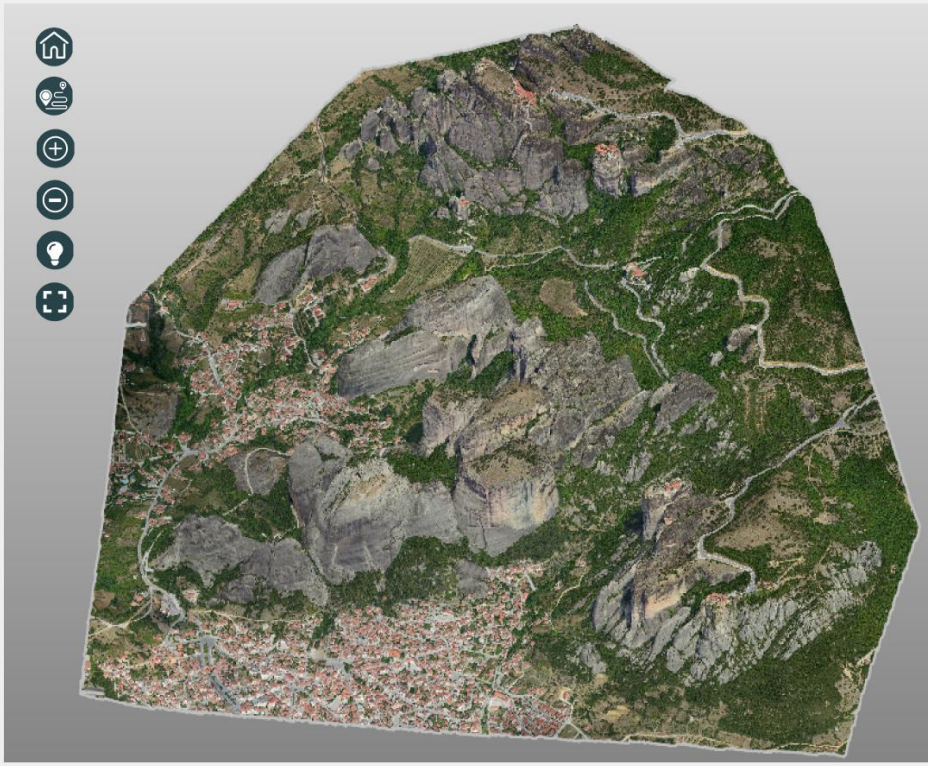
2D MAP & GEOLOCATION

2D Map & Geolocation: 2D Map API of the wider region with real-time tracking

Search for CH hotspots and local businesses (accommodation, food service, transportation, guides & tour operations etc.)

Brief description & general information for each spot





Display only near to the current user's position spots

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Augmented Reality

MOBILE APPLICATION

Use case of visiting the place of interest | Real-time guidance for tourists

Functionality:

- Superimposition of the 3D reconstructed model of the Monastery of St. Modestos, traces of which are found on top of Modi rock.
- Navigation to the predefined spots by the augmentation of the actual route with virtual instructions and graphics.
- Contact form for optional experience evaluation, optimization proposals and/or desired extra features and services.

Implementation:

OpenCV library with ARCore SDK for Android devices

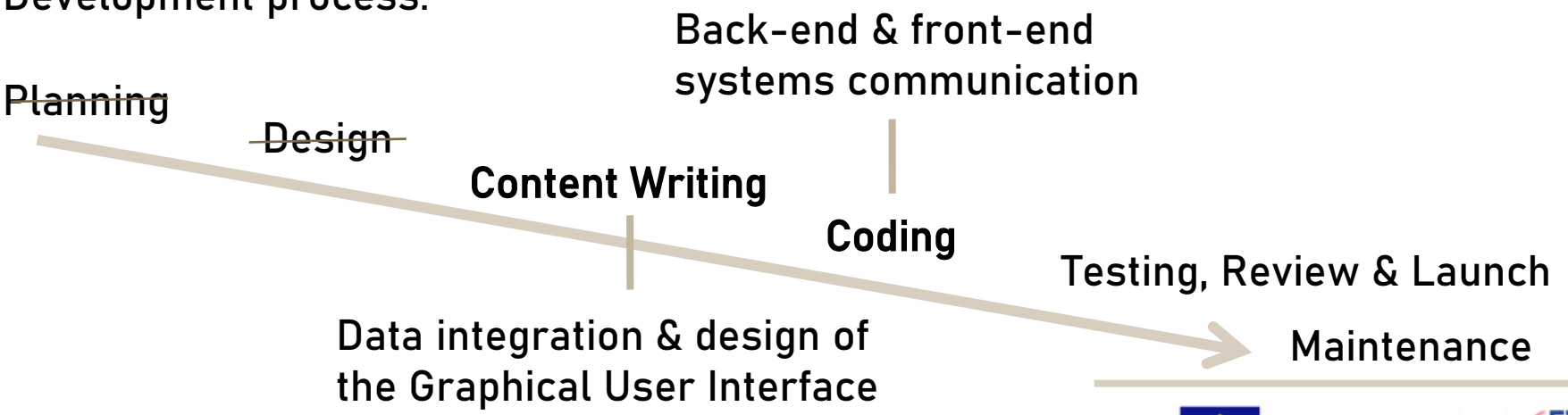
Conclusions

DISCUSSION & FUTURE WORK

Centralized and sophisticated visualization of diverse heritage data emphasizing on cultural tourism promotion and knowledge dissemination:

- Navigation mechanisms & virtual tours
- Ontological & scene-based search & retrieve tools
- Real-time tracking and guidance to local hotspots

Development process:



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