5dMeteora: Information System for Multi-Level Documentation of Religious Sites and Historic Complexes

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Key words: 3D viewer, 3D modelling, cultural heritage, visualization, Information System

SUMMARY

This paper presents the work conducted in the context of the ongoing research project "Information System for Multi-Level Documentation of Religious Sites and Historic Complexes: METEORA" (http://meteora.topo.auth.gr/). The aim of this project is the creation of a web-based platform for the organization, management, visualization and dissemination of the products of the multi-level documentation of the UNESCO site of Meteora, Greece, with emphasis on two inaccessible huge rocks in the Meteora site: the rock of St. Modestos, known as Modi, and the Alyssos rock. The platform, named 5dMeteora, integrates a 3D viewer based on the 3DHOP (3D Heritage Online Presenter) framework, personalized information access and interactive tools for virtual navigation, immersion, data retrieval and presentation. Both spatial data (high-resolution textured 3D models generated through combination of photogrammetric and surveying techniques) and non-spatial data (textual information, images and videos) related to historical, religious, cultural, architectural and geopolitical aspects of the two rocks of interest and the other monuments of the Meteora Archaeological Site are integrated in the platform. The content as well as the interactive services of the 5dMeteora platform are differentiated based on the scientific specialty and the field of interest of its users, serving their different requirements, based on properly structured scenarios of use, i.e., (i) tourists / simple users; (ii) geospatial engineers; (iii) archaeologists / architects / conservators; (iv) historians / philologists / theologians / priests; (v) educators; (vi) business entrepreneurs; and (vi) cultural heritage authorities. The 5dMeteora platform integrates an administrator interface for creating, updating and maintaining the functionalities of 3DHOP and customizing information based on the scientific specialty and field of interest of the users, offering automation in authoring, managing, uploading and updating 2D and 3D content and creating clickable points of interest on top of the surfaces of 3D models.

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1. INTRODUCTION

This paper introduces the research work conducted under the ongoing research project "Information System for Multi-Level Documentation of Religious Sites and Historic Complexes: METEORA" (http://meteora.topo.auth.gr/). The subject of this project is the creation of a web-based platform for users with varying requirements, which will promote the multi-dimensional documentation of the natural, religious, historical and cultural characteristics of the UNESCO World Heritage Site of Meteora. Within the project, techniques for spatial data collection, photogrammetric processing and 3D visualization of spatial models have been studied, the correlation of spatial data with an appropriately structured database has been addressed and an interactive and user-friendly platform that hosts both spatial 2D and 3D data, non-spatial information and different types of multimedia addressed to different users has been developed.

Meteora is located in central Greece and hosts one of the largest complexes of Eastern Orthodox monasteries. The Archaeological Site of Meteora is, after Mount Athos, the largest monastic complex in Greece. It is a region with particularly challenging topographical features, characterized by inaccessible giant rocks and cavernous structures. It features an active monastic community with a long history, from the 11th century. Nowadays, only 6 monasteries are still functioning, while ruins remain for several of the rest monasteries and hermitages. The part of the Archaeological Site of Meteora in which the novel techniques of the "METEORA" research project are implemented consists of two inaccessible huge rocks, i.e., the rock of St. Modestos, known as "Modi", on top of which ruins of the old monastery of St. Modestos exist, and the rock "Alyssos", where the monastery of the Chain of Apostle Peter used to exist. These giant rocks dominate in a central position in the Archaeological Site of Meteora. They are of great height (about 200 m), while the ascent to them is of increased difficulty.

Advances in photogrammetry and web technologies are transforming the way people perceive cultural heritage. The 3D geometric documentation extends its scope to include dissemination strategies and promotion of cultural heritage sites. However, besides entertainment and education, the metric and visual accuracy of the final photogrammetric products is also valuable. State-of-the-art research concerning the development of geographic information systems and web-based platforms that handle spatial data has been studied prior to the development of the 5dMeteora platform. For instance, structures for geographic information that support smooth zoom and handle both 2D and 3D data have been proposed (van Oosterom

and Meijers, 2011; 2014) and structures that implement continuous-scale 3D visualization based on a detail-increment model that avoids the disadvantages of a static Level of Detail (LoD) model have been discused (Ai et al., 2019). Also, several studies have been published proving the high potential of photogrammetry to restore archaeological and historic sites (Remondino and Campana, 2014; Bryan, 2017). However, only a few approaches share the results to potential visitors though immersive environments, like the work of Banfi et al. (2019), who developed a cloud platform for the visualization of the Basilica of Sant'Ambrogio in Milan. Also, the CyArk 3D Heritage Archive (CyArk & Partners, 2021) is an effort that began in 2003 to create an online repository for 3D cultural heritage data, generated via laser scanning and image-based photogrammetric techniques. Felicetti and Lorenzini (2011) reported the development of a semantic enabled and persistent repository, where 3D cultural heritage models as well as any kind of digital data and metadata can be stored, retrieved and shared. Another project related to the development of a repository for 3D cultural heritage models is MayaArch3D (Auer et al., 2014). Its main aim was the development of a web platform for storing spatial and non-spatial data, permitting visualization of 3D models and performance of GIS analyses on them.

The purpose of this paper is twofold: (i) it presents various types of data (spatial and non-spatial data) integrated in the 5DMeteora platform, giving details on the photogrammetric workflow followed for the generation of the 3D models of the complex study area; and (ii) it presents the 5dMeteora platform along with the administration interface for uploading, managing and updating its content. Although the case study is part of the Meteora Archaeological Site, the 5dMeteora platform along with its administrator interface may be extended, so that they adapt to different cultural heritage sites, while the proposed 3D modelling workflow may be tailored to other historical complexes of large extent and difficult topography.

2. Data Collection and Processing

The content of the 5dMeteora platform consists of both spatial and non-spatial data. In this section, the processes followed for the acquisition and photogrammetric processing of spatial data are described and the collection of non-spatial data is discussed.

2.1 Spatial Data

The 3D geometric documentation of cultural heritage sites of great magnitude and morphological complexity deserves particular management. The spatial data collection for 3D modelling of the two giant rocks of interest of the Archaeological Site of Meteora was accomplished by acquiring aerial images from a manned aircraft and an unmanned aerial vehicle (UAV) as well as ground control points (GCPs).

2.1.1 Data Acquisition

A total number of about 2220 vertical and oblique aerial images was acquired by a manned aircraft, covering the entire site of Holy Meteora, i.e., an area of about 10km^2. A NIKON D800E camera with a lens corresponding to a focal length of 50 mm was used. The images were taken from a flying height of about 600 m, with respect to the top of the rocks. Each image has a size of 36 MP and corresponds to a ground sampling distance (GSD) of about 5 cm. 47 ground control points (GCPs) were collected through RTK GPS measurements for the scope of georeferencing, using a dual-frequency GNSS receiver. Their coordinates in the Greek Geodetic Reference System ’87 (GGRS ’87) were determined.

Figure 1. Images from the process of spatial data collection for the geometric documentation of the rocks Modi and Alyssos in the Archaeological Site of Meteora.

Also, in order to capture the rocks Modi and Alyssos in greater detail, a Phantom IV RTK UAV with a 20 MP camera was used and a total number of about 5000 vertical and oblique aerial images was acquired. 21 flights were executed in different time periods from 6 different takeoff

and landing points, which were identified in accordance with the criteria of accessibility and visibility. Every mission was carried out in good weather conditions with little or no winds. The choice of time for flying was also a critical factor in order to avoid shadows due to the rocks during the day. The flights were manually operated, i.e., the operator maneuvered the UAV with full control, except for the missions that were conducted with a takeoff point at the top of Modi. In order to capture the images that cover the top surface of Modi and Alyssos, the shots were taken in the form of a pre-determined survey grid. The plans were uploaded to the UAV the day before the ascent and it was ensured that they are properly read by the software that runs on the UAV controller.

Furthermore, the acquisition of additional terrestrial images using a CANON EOS 6D camera featuring lenses with focal lengths of 24 mm and 35 mm took place. Terrestrial images were acquired – where it was possible, taking into account the complexity of the topographical characteristics of the area of interest – both at the bottom of the rocks Modi and Alyssos, as well as at the top of these rocks, where ruins of old Monasteries and other constructions exist. Along with terrestrial image capturing, 15 additional GCPs were measured in the area of the two rocks of interest. Some of the GCPs comprise points marked at locations around the rocks, where the access was allowed. The rest of the GCPs comprise distinguishable, durable and easily visible from high altitude physical points on the faces of the rocks as well as on the top of the Modi rock, where the surveying team had climbed. Images from the process of spatial data collection for the geometric documentation of the rocks Modi and Alyssos in the Archaeological Site of Meteora are depicted in Figure 1.

2.1.2 Photogrammetric Processing

For the generation of the 3D model of the entire Archaeological Site of Meteora using the aerial images captured by the manned aircraft, the following processes were sequentially applied:

- Structure from Motion (SfM) along with measurement of GCPs in the relevant images, for estimating the camera poses and a georeferenced sparse 3D point cloud from the images, based on photogrammetric and computer vision algorithms;
- Dense image matching and multiple view stereo (MVS), for generating a dense point cloud of the area of interest;
- 3D surface reconstruction (meshing), for creating a triangular mesh of the area of interst;
- texture mapping, for giving texture to the 3D mesh using the oriented images.

The Agisoft Metashape software (Agisoft, 2022) was used for the entire process, except for dense point cloud editing and meshing, which were conducted using the Geomagic Wrap software (Artec Europe, 2022). The dense point cloud that was derived consists of 353 million points. The surface model consists of 67 million faces and 34 million vertices. The camera positions derived by the SfM process along with products of the geometric documentation of the Meteora Site, using the images captured by the manned aircraft, are depicted in Figure 2. 3D views of the textured 3D model are shown in Figure 3.

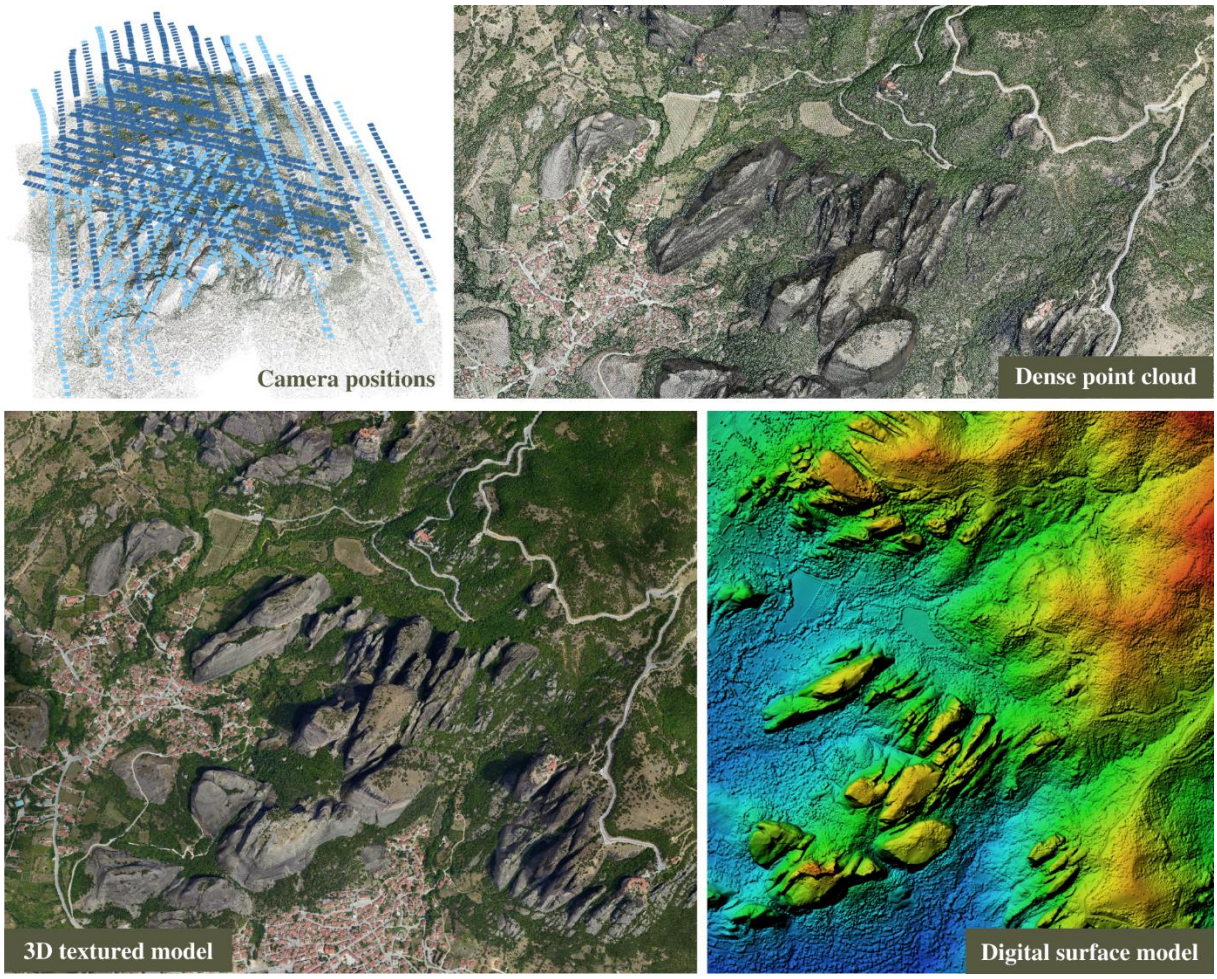

Figure 2. Camera positions superimposed on a sparse point cloud of the Archaeological Site of Meteora and products of geometric documentation of the Meteora Site, using the images captured by the manned aircraft.

A similar procedure with some additional manual steps was followed for the creation of high-resolution 3D models for Modi and Alyssos, using the UAV images. Several tests were accomplished for determining the most accurate solution that would yield satisfying results using the Agisoft Metashape software. The best solution was proved to be the separate alignment of the images corresponding to each of the two rocks (Modi and Alyssos), after reduction of their number, and the usage of masks to discard some parts of images from the SfM and dense matching processes. Specifically, at first, unnecessary and blurred images as well as images with low radiometric resolution, high noise level, intense lighting and shadows were removed from the initial dataset. Masks were applied to areas of the images with shadows, bad lighting conditions and sky and – in general – to areas that would probably deteriorate the final results of SfM and dense point cloud generation.

Figure 3. Views of the 3D textured model using the images captured by the manned aircraft.

The images depicting the rock of Alyssos were separated and three different solutions (projects) were created within the Agisoft Metashape software for each UAV mission over the rock. Specifically, a total of about 2100 images was used and the SfM process was performed using the "high accuracy" setting of Agisoft Metashape, which implies the extraction of feature points on each image of original size. After the successful alignment of images, the 3D modeling workflow included the generation of the dense point cloud. In all three projects, GCPs were measured in the relevant images. The three projects were merged into a single "chunk" with the use of the GCPs and dense image matching was performed. A similar process was followed for the images of Modi. Specifically, four different projects were created in Agisoft Metashape software, for each UAV flight that covered the rock. The GCPs were placed manually on the relevant images and they were used as a reference to merge the projects into a single "chunk". Dense image matching was then applied.

The conversion of the dense point clouds of the rocks to 3D meshes was carried out using the Geomagic Wrap software by reducing noise, deleting double surfaces and removing or manually rectifying the erroneous triangles. The 3D mesh model of Modi consists of 15 million

faces and 7 million vertices The 3D mesh model of Alyssos consists of 27 million faces and 15 million vertices. Finally, the image-based texture for the 3D models was built in Agisoft Metashape. The images were evaluated and their most focused areas for each part of the model were included in the process of texture mapping. The texture image files were exported in multiple JPG files of 10000×10000 pixels size to avoid a failure due to RAM limitations and attain the highest possible resolution.

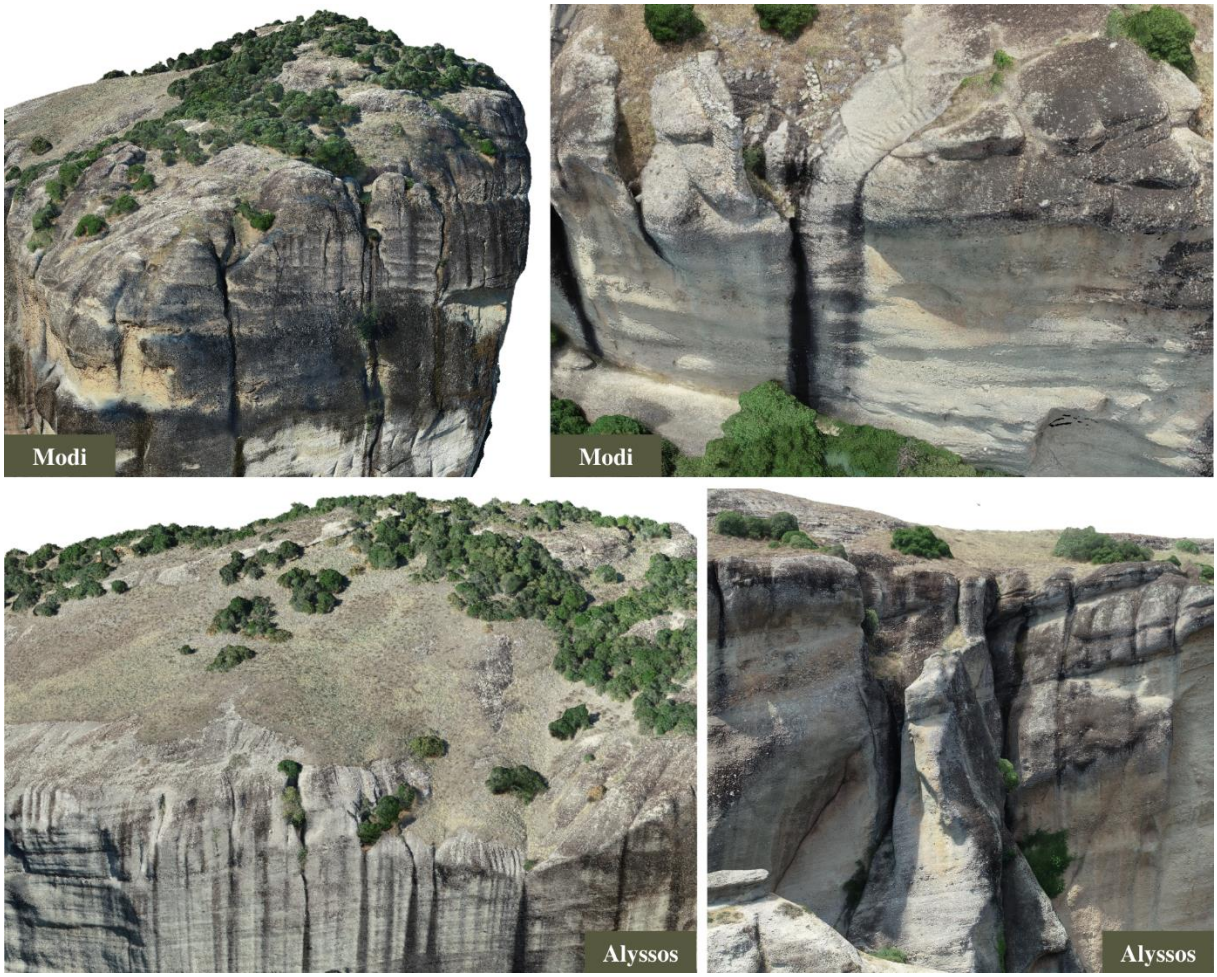

Figure 4. Views of the 3D textured models of Modi and Alyssos using the UAV images.

The 3D model of the Archaeological Site of Meteora as well as the 3D models of the rocks of Modi and Alyssos were converted into multi-resolution structures for being loaded in the display system of the 5dMeteora platform. This pre-processing stage allows for fast data transfer to the network and qualitative visualization. In general, multi-resolution schemes split geometry into smaller parts (patches). Each patch corresponds to a different level of detail. Their transfer to the web is done on demand, i.e., only the parts of the model that are absolutely necessary for the construction of each scene are rendered and loaded. The main advantages of this method are the fast start-up times and the reduced network load. The 3D model is immediately available for inspection in low resolution, which is gradually improved while new

patches are progressively loaded, depending on the current view-point. The dynamic adaptation of resolution depends on the position and orientation of the camera as well as the distance from the viewpoint. For the implementation of the multi-resolution technique, the JavaScript library Nexus.js (Visual Computing Lab, 2022) was exploited.

2.2 Non-Spatial Data

The collection and systematic documentation of non-spatial data focus on the historical, religious, cultural, architectural and geopolitical aspects of the two rocks of interest, as well as the other monuments of the Archaeological Site of Meteora. There is meager historical information about the first centuries of the operation of the monasteries of Meteora. In fact, the historical development of some of them remains almost unknown until their decline. In particular, the hagiologies and sequences/canticles of St. Modestos and the veneration of the Precious Chains of Apostle Peter have been studied and were partially recorded and the correlation of St. Modestos with other monasteries and churches in Greece and Balkans, as well as the etymology of the name "Modi" were documented. Scripts of the European travelers of the 19th and 20th centuries concerning the social, economic and national issues of the time as reflected in their narratives were also collected. Other information in the form of text concerns the historical development, the architecture, the iconography, the wood carving, the cultural values and the administrative status, as well as general information about the rest of the monuments of the Meteora Site. The bibliographic references as well as the source, the creator, the dates and other components of the archival material have been recorded, so that they are provided in the form of metadata to the expertised users of the 5dMeteora platform of the specialty theologians/philologists/historians/priests. Finally, the historical, archaeological and architectural documentation of the evolution of the tower and the other building infrastructures of the non-existent monastery of St. Modestos (findings, archival evidence, photo-interpretation, comparative study of towers, huts and buildings of the same period, materials and construction methods, etc.), the proposal of hypothetical graphic restoration and the drafting of the architectural plans for parts of the monastery have been reocrded.

The photographic material involves scanned manuscripts and excerpts of documents, relics, such as gold embroidery, portable icons, hagiographies, silver-gold liturgical utensils, wood carvings and silver-gold crosses, engravings, architectural plans, older and modern facades/sections of the exterior and interior of the monuments as well as documentation of the field work of the METEORA project team. The audiovisual material comprises old and present-time tours on the monasteries of Meteora, theological and historical narratives and snapshots from the team's outdoor activities.

Sources of the literature research include digital libraries, digital repositories as well as physical libraries of the Aristotle University of Thessaloniki (AUTh), the Society for Macedonian Studies (SMS), the Center of Byzantine Research (CBR), the Institute for Balkan Studies (IMXA) and the Sismanoglio Hall of the Theological School of Halki in Constantinople. Numerous manuscripts of imperial, hegemonic, patriarchal, metropolitan and monastic content were studied. Also, a number of old photographs of the area of Meteora were collected and

archived from digital photographic archives. Additionally, the personal data collections and the books of the publications of the Monastery of St. Stephanos constitute valuable sources of information. A detailed historical background of the formulation, organization and operation of the two monasteries of the two rocks of study was also provided. The narratives, engravings and travelogues of the 19th and 20th century travelers who visited Meteora, reflect past social and national issues as well as geographical, folklore and ethnological information. In addition, visits in municipalities and local communities, primarily in Thessaly, Epirus and Macedonia, but also in the wider Greek and the Balkan area as well as on Mount Athos, have been made in order to collect data on the folklore tradition. The recording of interviews of local authorities on the customs and traditions and the accumulation of photographic material by local people further enrich the available data sources. Examples of images from the collection of non-spatial data of the 5dMeteora platform are shown in Figure 5.

Figure 5. Examples of images from the collection of non-spatial data of the 5dMeteora platform.

3. The 5DMeteora Platform

The system architecture of the 5dMeteora platform lies on the 3-Tier Architecture model (Presentation Layer – Application Layer – Persistence Layer), which distributes the individual components in an optimal way, based on their functionality and applicability. The system of the 5dMeteora platform is based on the Apache web server, which is installed on a Linux operating system. The 3D rendering and visualization of the high-resolution textured models is assigned to 3DHOP (3D Heritage Online Presenter), an open-source framework developed by the Visual Computing Laboratory of ISTI – CNR (Potenziani et al., 2015).

3.1 Database Management System

The Database Management System is based on MySQL and its development environment is the PHPMyAdmin open software. The software allows the creation, editing and deletion of database tables and fields, the execution of SQL statements and the management of user rights. It includes a graphical interface for visualizing the structure of the Database, its tables with their interrelationships and their fields. The above technologies are open source and are released under the General Public License (GNU). They are accompanied by extensive documentation as well as a large and active community of developers. The various software tests on a local server were performed through the web software stack package, XAMPP.

The data model selected for converting the conceptual schema to an executable form by the Database system is the Relational Model. The entities are represented in the form of a table, with attributes and values. The correlations between the tables are of three types: (i) one-to-one relationship; one-to-many relationship; and (iiii) many-to-many relationship. The last degree of correlation requires the creation of a conjunction table. The tables and correlations of the database have been designed based on the criteria of long-term sustainability and flexibility. Two main entities emerge for the database design: “Point” and “Person”. The functionality for the “Point” entity focuses on spatial information and data management, while the functionality for the “Person” entity focuses on system configuration and access to the available data.

3.2 Administration System

A Content Management System, or Administration System, is a software used to create, modify, manage and extend content on a website, without the need for specialized technical knowledge. It has the ability to control large and dynamic collections of online material and facilitate its expansion and / or customization processes. Its development strategy is based on the following specifications:

- identification of content requirements;
- creation of structured and consistent content that can be reused;
- ensuring content compliance with international standards and guidelines.

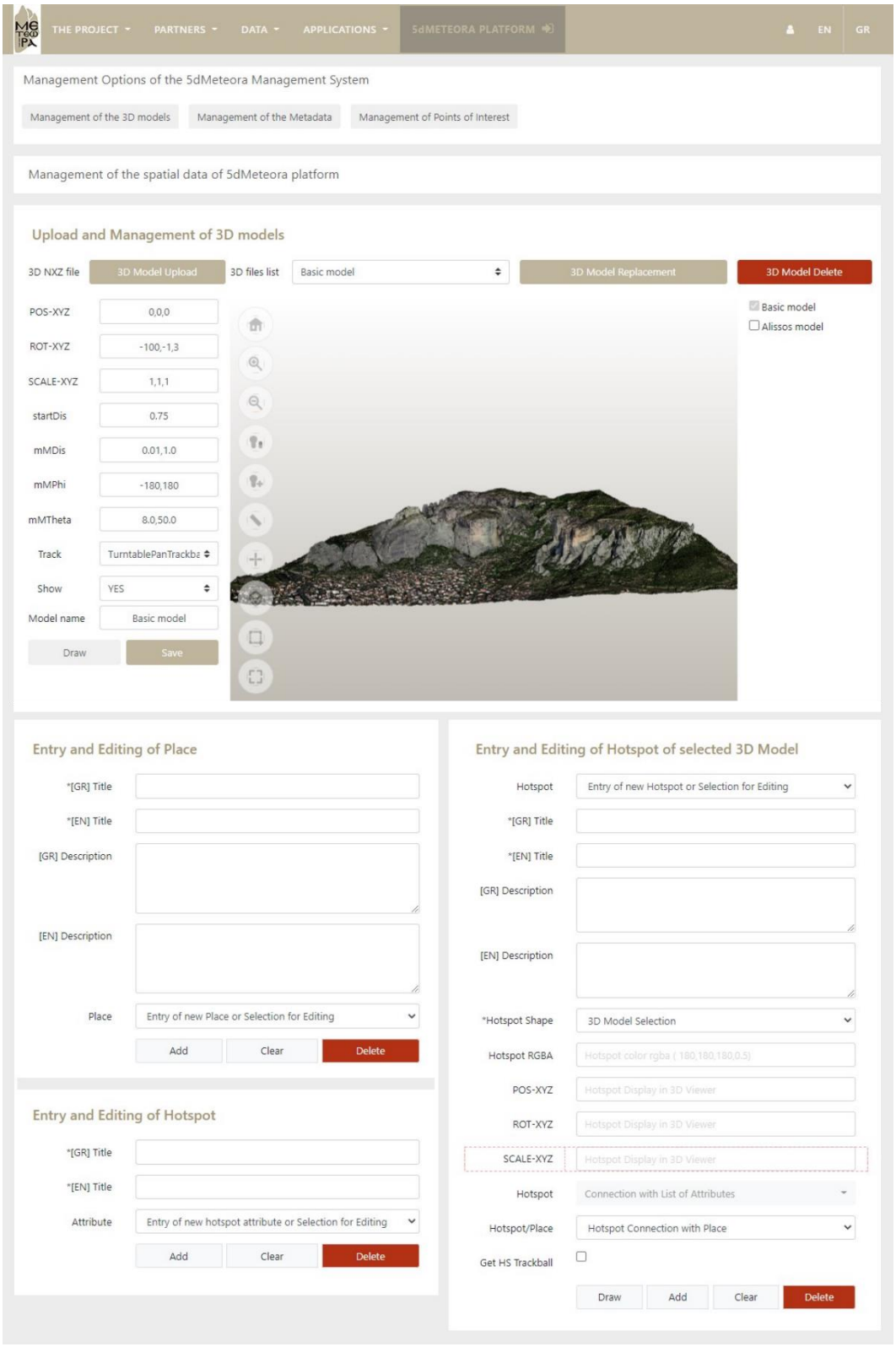

Figure 6. Administration system of the 5dMeteora platform.

The developed administration system (Figure 6) provides an efficient way to the administrators of the 5dMeteora platform for uploading, registering, managing and viewing models along with their relative multimedia, directly in the 3DHOP scene. It may be used by administrators who do not have any programming knowledge. Therefore, all CRUD (Create, Read, Update, Delete) actions can be easily accomplished by the administration system. The fields of the Database can be dynamically filled with the values entered by the administrator and, at the same time, they are retrieved with SQL and PHP queries from the front-end interface for immediate visualization and publication. The system is complied with the following safety standards:

- 3D file-specific encryption;
- data loss control mechanisms;
- detection and report of common errors to end users for being resolved by the creators of the Administration System.

The following actions are fully automated:

- uploading, adjusting and preview of the 3D scene;
- uploading and formatting of multimedia content
- Upload of points on the 2D map

3.3 Front-End Interface

The 5dMeteora platform consists of two Pages, the Main Page and the Multimedia Page. The transition from the Main Page to the Multimedia Page is accomplished via a redirect link (url), either through the 3D models or through the DataTables panel (see section 3.3.1). From the Multimedia Page, the visitor returns to the Main Page via a static button at the navigation bar. Their internal connection satisfies the need for interdisciplinary documentation of religious and cultural monuments, toponyms, special geological formations as well as activities and thematic areas located on the surface of three-dimensional models. The points where the internal links are placed aim at facilitating the transition of the visitors from the general spatial content to specialized multimedia content. The sitemap is shown in Figure 7.

Figure 7. Sitemap of the 5dMeteora platform.

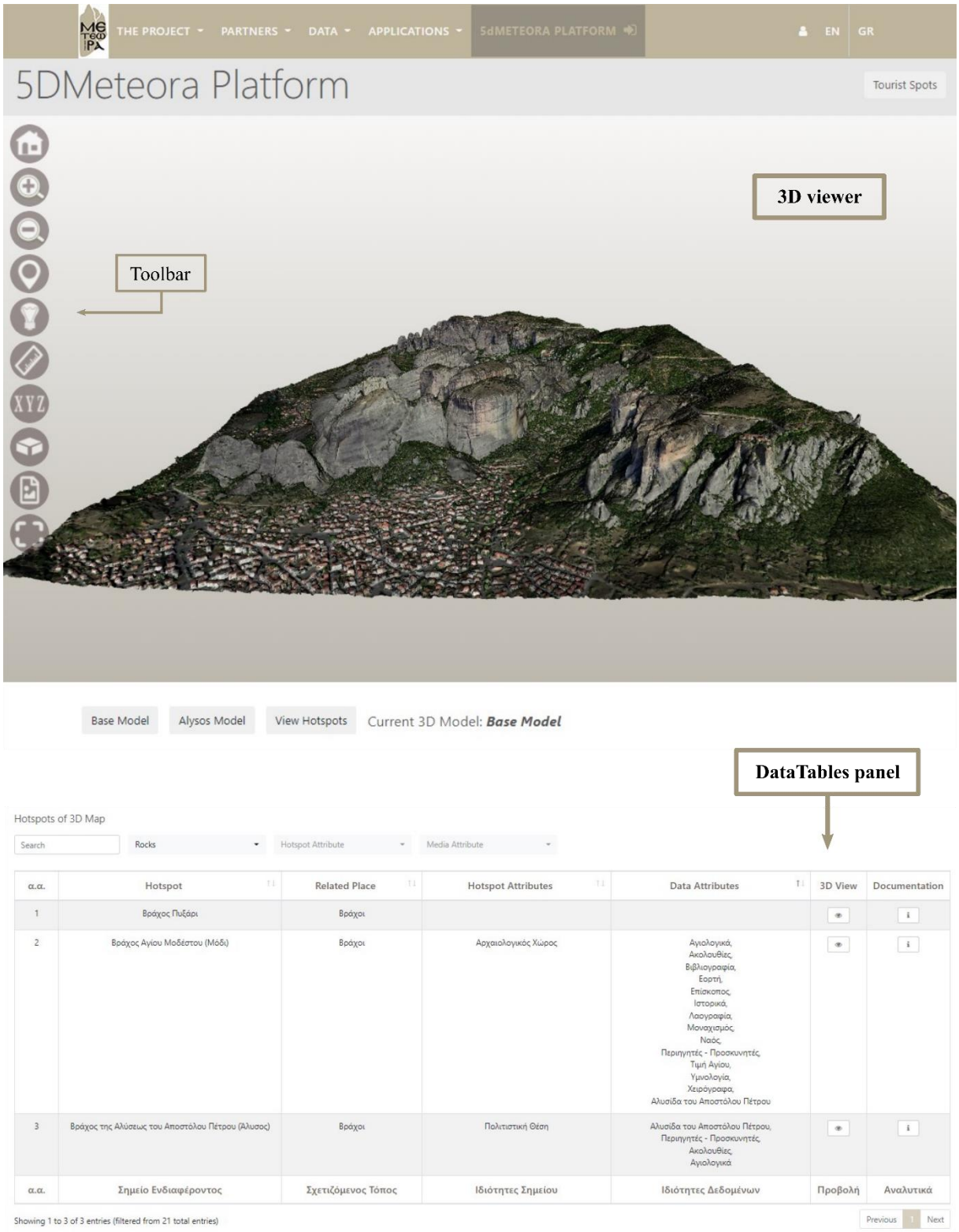

Figure 8. Main Page of the 5dMeteora platform, showing the 3D viewer, where the 3D model of the Archaeological Site of Meteora has been loaded, and the DataTables panel.

3.3.1 Main Page

The most important part of the Main Page is the 3D viewer, which is enriched and clarified by the DataTables Panel, located below it (Figure 8). The Three.js graphics library and the 3DHOP framework have been used for the development of the viewer; they support visualization of high-resolution 3D models along with interactive navigation, data recovery and spatial interconnection of the information that defines and clarifies the 3D scene. Within the 3D visualization system, interaction tools with the scene have been implemented (i.e., measurement tools, tool for changing the scene lighting, tool for highlighting areas of interest), in addition to the standard navigation method (i.e., panning, zooming and rotating). The resolution of the 3D models is constantly being optimized, depending on the distance of the navigation camera. The 3D model of the Archeological Site of Meteora forms the background of the viewer and is visible by default to the visitor. The selection of a point of interest within the 3D viewer leads to a preview of the multimedia material that enriches it with data (Figure 9). If the users wish, they are redirected to the Multimedia Page for its full documentation.

DataTables provides an overview of the information that accompanies each model, place or point of interest. Dropdown lists of each model's hotspots, each spatial entity metadata, and free text fields lead to specialized searches.

Also, nearby points of interest appear on a 2D map of the MapBox API (Figure 10). Each label of the map legend describes the general type of services or products offered by a specific business or cultural heritage site. Once the platform visitors select one of the map symbols, the name, a brief description and contact information are displayed in a pop-up window.

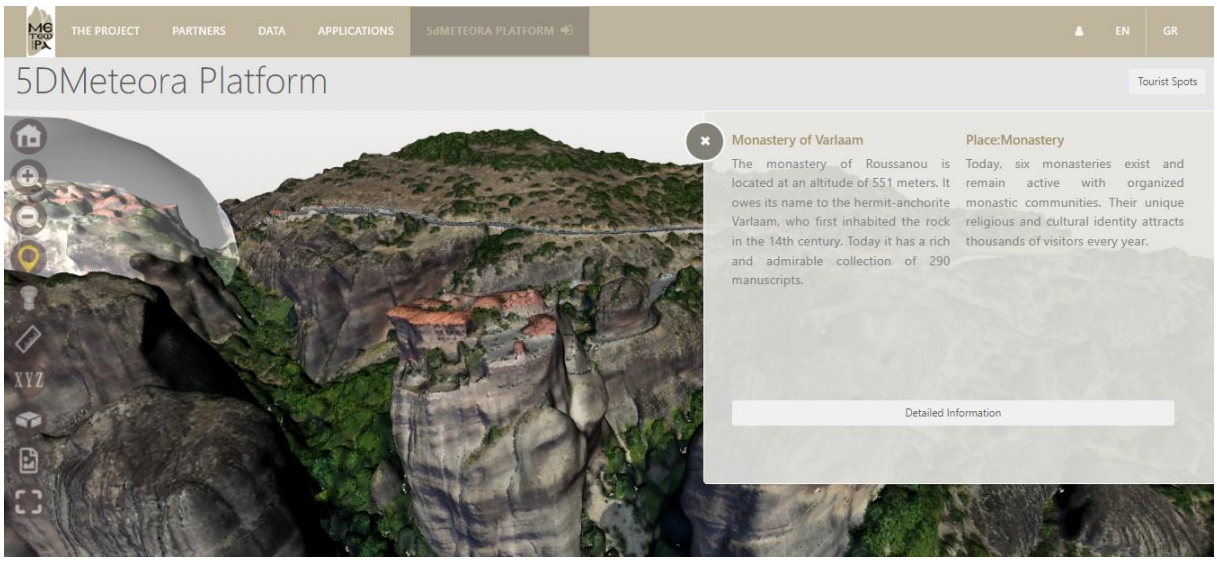

Figure 9. Pop-up window of multimedia material that clarifies and enriches a user-selected point of interest.

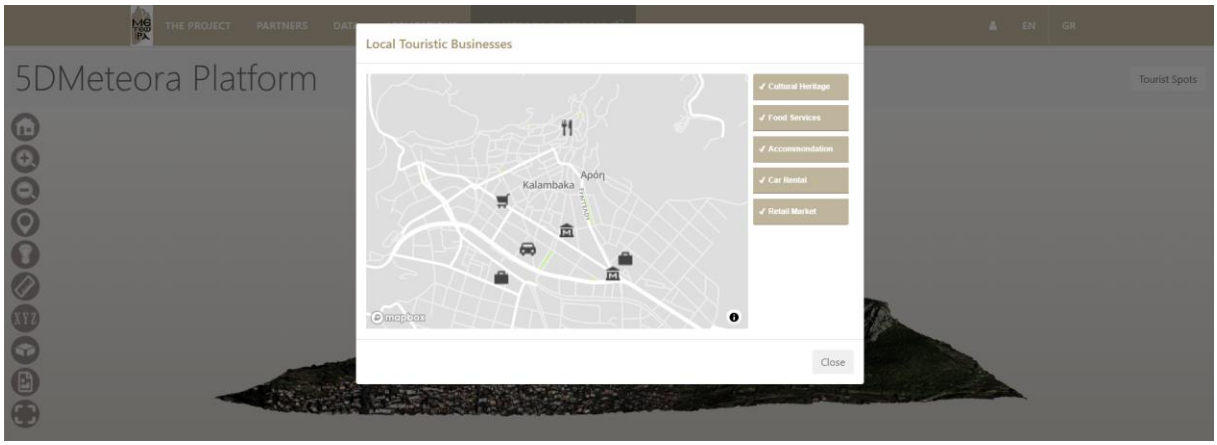

Figure 10. Pop-up window of the 2D map, displayed on top of the 3D viewer of the 5dMeteora platform.

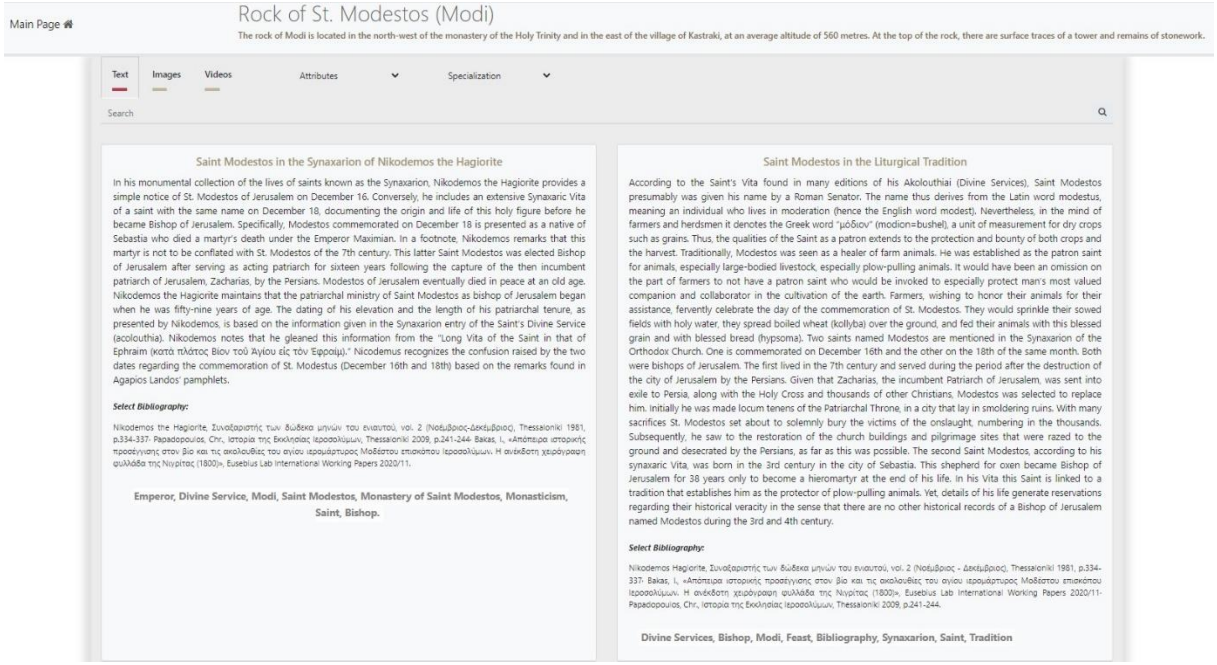

Figure 11. The Multimedia Page of the 5dMeteora platform, where information in the form of text regarding a point of interest is displayed.

3.3.2 Multimedia Page

Taking into account the fact that interdisciplinarity and personalization in the provision of information are goals of the 5dMeteora platform, the text documents, images and video files of the Multimedia Page are organized into specialized thematic and scientific fields. The texts, images and videos may be directly visualized thanks to the reading, viewing and playback functions, respectively (Figures 11-13). The Multimedia Page displays multimedia of general content or of more specific content categories, such as religion, architecture or archeology.

These media files provide complete documentation of all aspects of the point of interest to which they refer. However, visitors wishing to deepen their knowledge into a scientific field are provided with additional multimedia files, which are not visible by default on the Multimedia Page. Thus, a dropdown list containing the following specialized content has been designed: (i) Geospatial, (ii) Archaeological - Architectural, (iii) Theological – Historical and (iv) Educational. If the visitors select one of these categories, they are given access to multimedia files that are the results of scientific research in the respective field.

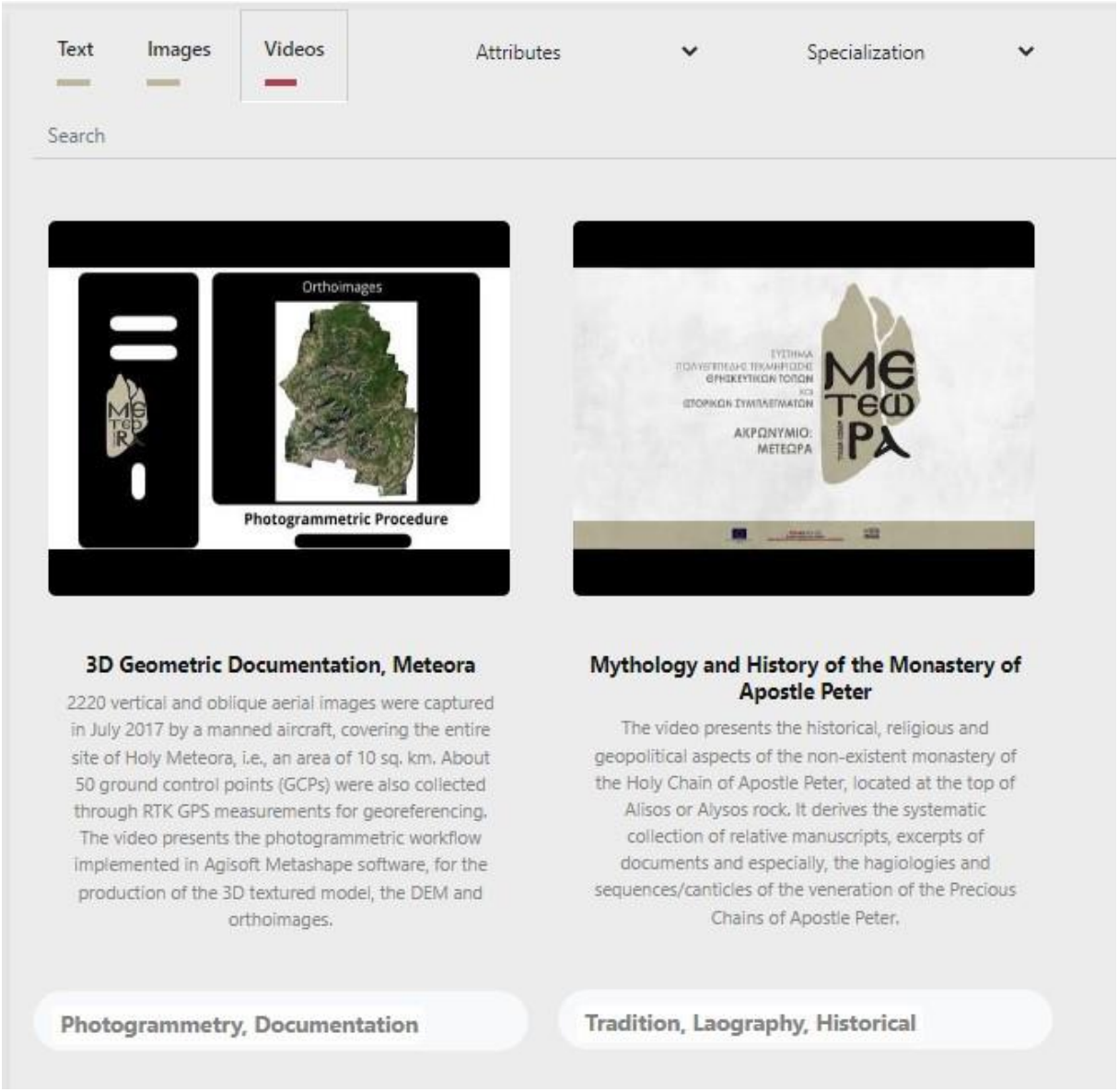

Figure 12. Part of the Multimedia Page of the 5dMeteora platform, where videos regarding a point of interest are displayed.

As far as search functions are concerned, the users may determine the type of information they want to retrieve, either through a dropdown list with all the metadata tags or by entering keywords in a free text field. Tags indicate semantic correlation, logically categorize data and act as search filters. Keywords are also assigned to each saved hotpot and place, specifying their topic category or content. The keyword entities that match the query terms and are relevant to the users' information requests are retrieved from the repository.

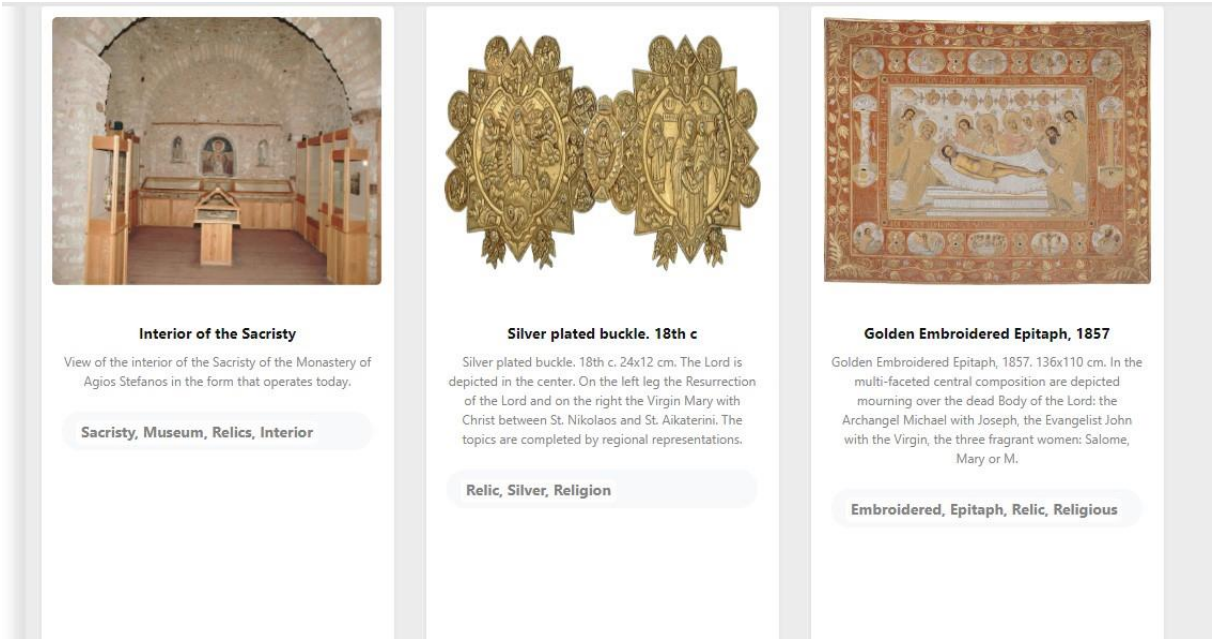

Figure 13. Visualization of images related to a point of interest within the Multimedia Page of the 5dMeteora platform.

4. Discussion and Conclusions

The technical contributions of the work conducted within the METEORA research project concerning the development of the 5dMeteora platform can be summarized as follows.

- The proposed administration system allows dynamic content management, automation of 3DHOP's operations regarding 3D data uploading and hotspots defining, real-time preview of the 3D scene as well as extensibility at all levels (e.g., new data types, etc.).
- The content and interactive services of the 5dMeteora platform are differentiated, based on the scientific specialty or the field of interest of the users.
- The 5dMeteora platform offers data retrieval and analysis mechanisms through navigation tools, annotations and customized services for various use cases.
- The 5dMeteora platform offers a responsive and easy-to-use 3D visualization schema.

The 5dMeteora platform may be extended, so that it adapts to different case studies. In this way, its use will not be limited to the promotion of the Archaeological Site of Meteora, as it may

integrate any spatial and non-spatial data that refer to different cultural heritage places. Thus, the 5dMeteora platform may be used by members of a local authority dealing with cultural heritage, to promote the cultural heritage through a modern and innovative platform and attract a new generation of visitors, as well as promote the work conducted by the authority. However, evaluation tests remain to be conducted in order to release the final version of the 5dMeteora platform and draw the final conclusions.

ACKNOWLEDGEMENTS

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1992-1996: Co-chair of Commission VI-WG2 'Computer Assisted Teaching' in ISPRS.
1997-2001: Member of the Directing Council of the Hellenic Mapping and Cadastral Organization and Deputy Project Manager of the Hellenic Cadastre.
2011-2018: Chair of Working Group 3.2 'Technical Aspects of SIM' of FIG Commission 3.
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Scientific responsible of more than 20 research projects. He has published more than 200 reviewed papers in scientific journals, books and proceedings.

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Sofia Soile obtained a diploma in Rural and Surveying Engineering (1995), Master of Science (MSc.) in Geoinformatics (2013) from the NTUA. She is a member of the Lab. of Photogrammetry of the SRSE of NTUA teaching in undergraduate and postgraduate courses. She has a broad professional activity in the fields of Photogrammetry, and Computer Vision and she has worked as a Researcher in more than 40 Research Programs, aiming at the Photogrammetric Data Acquisition and Processing, 3D scanning via Laser Scanners, White Light Scanners, Handheld Scanners, 3D Modelling of Sites, Industrial Applications, Spaces and Complexes Objects, 3D applications for monument restoration, CAD modelling, 3D Inspection, Structure Monitoring, Deformation Analysis, Processing and Modelling of Point-Cloud Data, BIM Modelling, Computer Vision Techniques in Monuments, Multidimensional Spatial Systems Information, etc. She is co-author in more than 50 scientific papers in the fields of photogrammetry and compute vision, that have been published in peer-reviewed International Scientific Journals and Conference Proceedings.

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Argyro-Maria Boutsi received a diploma in Rural and Surveying Engineering from the National Technical University of Athens (NTUA), Greece, in 2019. She is a research member of the Laboratory of Photogrammetry of School of Rural and Surveying Engineering (SRSE) and she is currently pursuing a PhD degree in Augmented Reality from National Technical University of Athens. The subject of her doctoral dissertation is "Photogrammetric techniques and algorithms optimization for the development of interactive Augmented Reality systems". Her research interests lie in the fields of photogrammetry, augmented reality, computer vision and 3D computer graphics. She has two peer-reviewed journal article and ten peer-reviewed conference papers on topics including 3D web visualization and computer graphics, web development and mobile Augmented Reality.

Styliani VERYKOKOU

Dr. Styliani Verykokou obtained a diploma in Rural, Surveying and Geomatics Engineering (2013) from the National Technical University of Athens (NTUA), Greece, achieving a grade of 9.29/10. She has been awarded several scholarships and awards by the National Institute of Scholarships of Greece, the NTUA, the Academy of Athens, the Technical Chamber of Greece, the Thomaidion Foundation (Greece) and the Limmat Foundation (Switzerland), as a result of her performance in her studies. She obtained her doctoral degree in Photogrammetry from the School of Rural, Surveying and Geomatics Engineering (SRSGE) of NTUA in 2020. The subject of her doctoral dissertation was "Georeferencing procedures for oblique aerial images" and it was supported by the Eugenides Foundation scholarship. She has participated in several research projects in the fields of photogrammetry and computer vision and has authored more than 25 peer-reviewed scientific papers in these fields. Currently, she is a post-doctoral researcher at the Lab. of Photogrammetry of SRSGE. The subject of her post-doctoral research is "Theoretical and practical approaches to 3D modelling for special applications".

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Ilias Pastos obtained his Bachelor degree from the Department of Cultural Technology and Communication of the University of the Aegean in 2005 and from the same department, his Master of Science (MSc.) in 2007. His MSc. is specialized in cultural informatics. He has worked as a researcher and developer at several research programs at the University of the Aegean and he has a broad professional activity as a web developer in the fields of interactive multimedia. His expertise is web applications and particularly relational databases IT development under advanced programming languages like PHP and JavaScript. He now works in the Central ICT Infrastructure Directorate of the University of the Aegean as a developer.

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Ioannis Tallis is a Dr. in Cultural Informatics, teaching in undergraduate and postgraduate courses, and a researcher in cultural heritage technologies. He obtained a diploma in Cultural Technology and Communication (2004), Master of Science (MSc.) in Cultural Informatics (2006) and a doctoral degree in the field of Cultural Informatics and Computer Science (2014) from the University of the Aegean. During his studies he received scholarships of the "AG Leventis Foundation" (2009-2010) and the "Propontis Foundation" (2007-2009) and he was an academic researcher at the Kingston University - Faculty of Computing, Information Systems & Mathematics in London (2010-2011). He has been a member of two research laboratories at the University of the Aegean where he has also worked as a researcher and developer in research programs. He is co-author in several scientific papers in the fields of heritage, multimedia development, interactive storytelling, virtual exhibitions and 3D graphics cultural representation. His research interests and professional experience focus on the development of innovative IT systems with emphasis on cultural heritage networking, educational technology with interactive multimedia and museology applications. He is currently a research member of the Laboratory of Topography (LabTop) of the School of Rural and Surveying Engineering at the Aristotle University of Thessaloniki and instructor of the BA Animation & Interactive Media at AKTO - Middlesex University in Thessaloniki.

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Panagiotis Tokmakidis is a surveyor engineer graduated in 2004 from the school of Rural & Surveying Engineering of Aristotle University of Thessaloniki, he has a great academic and professional experience in the field of monument surveying. He has completed more than one hundred projects concerning monument surveying using conventional, photogrammetric or LIDAR techniques assigned mainly by the Greek Ministry of Culture or by foreign archaeological missions working in Greece and abroad. He is a PhD candidate at the School of Civil Engineering at Aristotle University, Greece. He worked as a teaching assistant at the Technical University of Cyprus, Limassol. He has given lectures on monument surveying on summer courses and seminars offered by the department. He has been guiding postgraduate and undergraduate diploma thesis during the last fifteen years at AUTh. He is a research member of the Laboratory of Topography (LabTop) of the School of Rural and Surveying Engineering at Aristotle University of Thessaloniki. He worked for five years at the successfully completed, ERC funded, project "PlantCULT", as a GIS engineer.

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