SCIRES it
SCIentific RESearch and Information Technology
Ricerca Scientifica e Tecnologie dell'Informazione
Vol 15, Issue 1 (2025), 177-192
e-ISSN 2239-4303, DOI 10.2423/i22394303v15n1p177

CASPUR-CIBER Publishing, http://www.sciresit.it

3D COLLECTING DATA, THE INTERDISCIPLINARY PLATFORM

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Abstract

The work focuses on the experimentation of digital technologies applied to Cultural Heritage, consciously choosing of the most suitable means to ensure communication and dissemination of scientific knowledge. The research shows the creation of 3D Collecting Data* aimed at coordinating together interdisciplinary languages belonging to different fields of study, overcoming the tool of simple repository data. This work is still in progress, and it is based on the potentialities of the 3D model and the eloquence of drawing through maps and descriptive indicators at different scales. The methodology involves daily 3D processing, proposing a visualization of the archaeological excavation. This leads to a "digital reversibility of the excavation" that can implement discipline and offer itself to the control of researchers. An open-source method that constitutes an interesting novelty. The case study examined is the site of the church in the old city of Ascalona (Israel).

Keywords

3D Data Management, Integrated Survey, 3D Viewing System, New Interdisciplinary Platform.

1. *The case study, Santa Maria in Viridis, Ashkelon (Israel)*

The research was carried out in the period from 2020 to 2023 overcoming the problems of pandemic restrictions and ongoing war.

Unintentionally, an unexpected cultural responsibility weighed on the research activity due to the risks of the Israeli-Palestinian conflict spread few days after the latest mission on field, raising the danger of delating all the historical elements. The research could represent today, perhaps, the last evidence of it (Luschi et al., 2023).

The archaeological site is located on the south of the Israeli coast, over twenty kilometers from the city of Gaza and from the city of Azoto (today called Ashdod). The city of Ascalona (Ashkelon) is at the center of the coastal front of the Neghev desert region, equipped and defended since antiquity (Fig 1 - 2).

Today the area is in a critical geographical situation, for being on the Israeli-Palestinian frontier. Its history tells us that precisely because of its geographical location it had become an important frontier center over the millennia. The city of Ascalona, defined as a city-state at the center of a free-trade area, has always been contended but almost never conquered for long periods of time.

Fig. 1: Map of the Levant coast (Itinera Hierosolymitana Crucesignatorum I, 12th-13th century) with the Via Maris route highlighted in red

1.1 *The city of Ascalona*

The historical documents can be divided into two major groups: the Arabic and the Latin sources. On the base of these, the reconstruction of the great history rests. Ascalona was destroyed by Bybars in 1270 and it seems to fall into oblivion,

Fig. 2: Aerial view of the entire site of ancient Ashkelon and the extension of the new city

until the centuries of travels and pilgrimages of the XVIII and XIX centuries.

The ruins of the city were unearthed during the Ottoman period (XVI-XX centuries AD) by the archaeological mission of Lady Hester Stanhope in 1815 (Stager et al. 2008). The site is then examined by Palestine by the Exploration Fund (PEF) of Conder and Kitchener, during the British Survey of Western Palestine in 1874-75.

Thus, the first scientific excavation of Ascalona was conducted by archaeologist John Garstang and his assistant W. J. Phythian Adams of the Palestine Exploration Fund in 1920-1922. There follows an underwater survey by the Center for Maritime Studies of the University of Haifa (1985-87), the expeditions of the IAA (Israel Antiquities Authority), which conducted submarine and coastal studies (1992-97) and those of Leon Levy (1985 - 2006).

The complex stratification of civilization and history is therefore reflected in an articulated archaeological sedimentation that corresponds to ancient Ascalona. The new city is developed outside its borders. Since 1964 the ancient city is preserved by an archaeological park (Ashkelon National Park) that traces the boundaries from the layout of its walls.

Recognized the historical depth of the site, the city of Ascalona is defined in its morphology from the Roman era (Luschi, Stefanini, & Vezzi, 2021).

1.2 Santa Maria in Viridis according to studies

Among the archaeological byzantine evidences within the site of ancient Ascalona, the church of Santa Maria in Viridis is located in the area close to the main gate of the city, called Jerusalem Gate.

Archaeologists identify the ruined church of Santa Maria in Viridis as a three-nave church with a central baptismal font, providing different representation hypothesis (Hoffman, 2019).

Several considerations guided the archaeological excavations in identifying the original structure as a Roman Viridarium: it is a garden within a palace that was organized by at least two terraces on a podium with side stairs.

This is proven by the excavation of the apse, which returned a marble-lined pool, and a podium about 40 meters long.

The apse of the church, moreover, shows obvious reuse, perhaps even in the Byzantine sphere. The intentionally archi-acute niches date the rearrangement back to the Crusader period (Fig. 3).

Fig. 3: Context view of Santa Maria in Viridis. Drone flight, AskGate Mission 2023

2. *The design of an integrated representation: Principles of Virtual Archaeology and methodology*

The topic of Virtual Archaeology has been debated for at least 30 years. The methodologies, technologies used, and critical theoretical aspects and research perspectives are constantly being updated (Reilly, 1990). Digital virtualization is a modeling of reality through geometric entities that describe the archaeological context.

The real language to be coordinated is first to clarify the ontological level from which one starts in order to understand the methodologies implemented by each group. Data processing must have a rigorous output, in accordance with the London Charter and better specified in the Seville Principles (2017) (López-Menchero & Grande, 2020). But there is even before that an ethical warning addressed to drawing and representation within the Restoration Charter and Venice Charter. Drawing must maintain fidelity to the truth for the preservation of the authenticity of the sources and the document, thus also the architecture. The concept extends, of course, to all the information to be found, and thus fidelity goes to inform the method of work in all its parts (Leone & Perini, 2023). There is need to make an schema that highlights the frameworks, the nodes of comparison between disciplines, and the checkpoints for each iter and for the general iter (London Charter, 2009). The methodology to be applied must be based on interdisciplinarity, and not limited to multidisciplinarity. (Science Europe, 2018). Moreover, it must be considered that a digital model may be a copy and not a digital twin.

The ontological reality of the architectural document will have to be digitally represented according to a principle of approximation to be accepted and incorporated into the dimension of acceptable discretisation (Pietroni & Ferdani (2021).

The topographic survey becomes the basis for a digital model, metrically reliable, and with acceptable error in relation to the type of analysis in the architectural, archaeological and micro-archaeological fields. The digital vector model, once validated will have to support the mesh which has different nature and different characteristics. The real current problem of digital representation, in its dimension of formal and metric fidelity is how a mesh actually matches to the vector model.

The issue is limited by the acceptance of an approximation related to the definition of the image, the computational capacity of the hardware and the reliability of the survey activities. These three steps increase the error to be accepted within the methodological procedure. Therefore, it is not valid to think of a refining of the data in relation to the output scale, but must be considered at the visualized portion of the model (LOD Level of details).

To project a common plan of action, means to visualize the spatial dislocation of different disaggregated data. The context of which is provided at the right scale. The 3D model then must adapt to disciplinary needs without giving up the principles of correct representation of the architectural document.

Architecture is not only made of tangible elements, but it is also a bearer of thoughts, social relations, and intangible processes that made it a real protagonist of history. This explains why understanding and preserving the structure means also understanding and preserving its intangible values and heritage. Therefore, the research tends to identify the reasons behind an historical monument, looking for them both in the materials and in building knowledge. Dealing with the dynamism of the study in the context of historical buildings in archaeological sites means having to examine an individuality, which is expressed in parts, all representing a singularity.

The idea of this digital structure means you don't have a standard in any case at all. The data to be collected for research are of a different nature, but can be compared and correlated in the results processing phase. The limitation of such a data record is related to storage capacity. In this case it is provided within a virtual server of the University of Florence System (GARR). The thematic implementations to be validated and then put into the server will be allocated to the off-line activity. The digital media are chosen according to the type of representation and the guarantee of the highest degree of flexibility.

The historical source, or cultural heritage, to which we owe loyalty is therefore not only the physical formality of the artifact, but even more important: its content.

A further aspect of research ethics concerns the second principle of the London Charter, which states: it should not be assumed that digital visualization is the most appropriate means of addressing every research and communication objective in the field of cultural heritage.

In the next point of the same Charter for user protection, it is requested that the digital visualization of a cultural property make explicit its reconstruction based on evidence or instead on hypotheses, as well as the extent and nature of any uncertain information.

In fact, already the Restoration Charter and to follow the Venice Charter, specify this aspect, to safeguard that principle of fidelity mentioned above. However, today, we see spectacular and well-done reconstructions in the digital environment that abandon the representation of reality. These overlapping modelling engages the observer to such an extent it as truth, without asking for feedback. Of this, the end user must be warned to be made aware.

Lastly, it is important to deal with the principle of accessibility, aimed at improving access to the monuments themselves, which are otherwise inaccessible to those with health problems d with disabilities, or to those with economic, political or environmental impediments. Such monuments may also be inaccessible because could have been lost, damaged, dispersed, destroyed, restored, or reconstructed. Referring to the Ashkelon site, this principle seems to be clear given the emergency of the conflict in which it is located.

Wanting to go beyond the aspects exemplified above, it seems fair to consider the problem of user freedom in the presence of digital representation (Norman, 1986).

The operational methodology of the interdisciplinary research is organized with the intention of making the work open, accessible, and faithful, keeping it together and making it speak by each part. At the same time, attention was given to J. Nielsen's (1995) operational decalogue.

2.1 Languages to coordinate, data typology and virtual reversibility of the excavation

The interdisciplinarity created in the collaboration within the present research, led to the need to develop a protocol of actions that would preserve the general principles of Virtual Archaeology. That would include operations suitable for the proposal of virtual reversibility of the excavation and contextualization of the elements analysed both physical and chemical (Gabellone, 2019; Luschi & Lecci, 2023). All of this to reach a common understanding of the work done in the different fields of study. The various languages to be coordinated are therefore distinguished: historical, micro-archaeological, architectural and archaeological.

In the communication between the various disciplines, we look for a method of restitution that is able to transform the action carried out in the field into a scientific result that has a spatial positioning, a personal detailed visualization and an effectiveness of the outline. In drawing, therefore, a meta-language is identified which, through three-dimensional representation, can graft a biunivocal relationship between the different fields of study. The plans, façades and sections will however be part of a traditional documentation system together with descriptive texts to support the topics covered.

Then we look for a method of optimization of the representation of the specific data, able to facilitate its reading during the return phase, both to experts of the discipline of reference, and to other scholars who are part of the research.

A first processing of the data collected during the excavation days leads to distinguish the following types of information, properly managed and stored:

- historical documents, images and photographs;
- metric spatial architectural data obtained through the return of the topographic material on which the 2D representations of plants, elevations and 3D of the photogrammetric model are based, appropriately scaled and referenced;
- archaeological data of special findings,
- micro archaeological data of samples taken from the site.

It is therefore necessary, first of all, to record the spatial coordinates of the sampling points within a three-dimensional, scalable and dynamic architectural model, that makes the samples directly comparable and readable at an appropriate scale.

At the same time, archaeological and architectural language need to be optimized to be colloquial. During the daily excavations the special finds were archived according to the compilation of data sheets. The indication of the altitude, the locus and the basket was used to determine their location within the corresponding excavation area.

The spatial data (x, y, z) of the discovery acquired initially with the topographic survey are thus transposed and effectively inserted in a three-dimensional space, favouring their visualization in an explorable context.

Through the overall vision, therefore, the spatial comparison of findings is encouraged, promoting subsequent questions on the identification of compositional transformations of the architectural type, indicating the different changes of historical periods of the site.

This type of archaeological reading of 3D space leads to a need to contextualize all those studies on the masonry texture (Mediati & Brandolino, 2024).

This also identifies the studies of construction technologies and the critical system of the masonry stratigraphic units.

The attempt to connect the archaeological world with the architectural one through an overall, spatial and three-dimensional vision, is applied in the experimentation of new technologies and methodological protocols to make the irreversible activity of excavation virtually reversible. Usually, the archaeological excavation foresees the irreversibility of the action, because it destroys those layers that make up the surface of the area, although documented with topographic dimensions, descriptions and photographic material.

The processing of the daily photogrammetric data, metrically controlled by the topographic survey, has led to graphic reconstruction of the excavation areas able to visualize the different daily changes in the state of work. The graphic elaboration proposes the advancement of the excavation in depth linked to its real context.

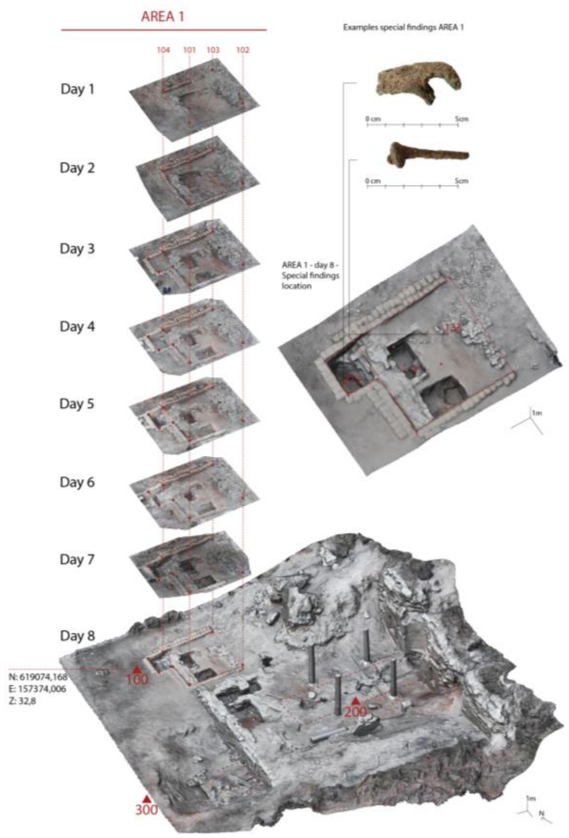

Fig. 4: Representation of the reversibility of the excavation within the 3D model where the finds are indicated for each layer (Luschi & Lecci, 2023). AskGate Mission 2022

This makes it possible to retrace the excavation even after its ending in a deferred space and time.

It is possible to analyse directly on the 3D element by year, month, day, all the information such as dimensions, proportions, localization of findings, more immediately and even more linked to the overall view of the case study. The three-dimensional models become overlapping in temporal succession and can be consulted within a spatiality always linked to the context to be analysed, becoming themselves a tool for helping any further study and analysis and better understanding any individual finding. From the archaeological point of view, its limit is the identification of *locus* (layers) and their representation that still is shown by sections.

The compromise is accepting that we do not have a model based on archaeological plans but structured according to a reversible model of daily activities (see Fig. 4).

2.2 3D visualization mode of the collected data: the use of digital model

Once the elaboration and archiving of all the data obtained in the field is done, we need to manage and organize them according to representation systems for the development of the monument (Vallet, 2012).

The modes of digital representation of reality and reconstruction of what we see in digital, when they are not single static images, are divided into linear and non-linear audiovisual. Many static images that are joined together form the frames of a video. The last one is identified as a linear audiovisual system because it has a timeline from point A to point B, already rendered. Examples include videos, gifs, and 360° videos.

By nonlinear audiovisual systems, however, is meant all those representations where the particularity is in the decision of camera movement and what to see. This is not totally up to the director, but it is the user who has the opportunity to explore, change scenes, or stay in a place for a long time. This mode of representation gives the user the illusion of enjoying a sense of freedom. An explanatory example is video games in which there is a rendering that takes place in real time. The only tool the director can use to guide exploration in a nonlinear audiovisual is to intervene through storytelling elements, which can appear in the scene and attract the user's attention.

Most Machine Generated Reality falls under the definition of nonlinear audiovisuals, being representations of environments artificially constructed by humans for fruition on digital media. Within this classification is the term of XR (Extended Reality) which goes to indicate all those digital representations, which are linked to the surrounding reality, full or partial immersiveness through device (Laato, 2024; Gatto & Semeraro 2024; Lasorella, Cantatore, & Fatiguso, 2021).

Speaking about the case study of this work, the focus is on an archaeological site characterized by interdisciplinarity and multi-language research.

The structures defined above spark different relationships between what is represented and the user. Audience involvement in a linear audiovisual system is given by the emotion that the director's work manages to provide (passivity of fruition), while in the case of nonlinear audiovisual the user is stimulated by the mutual interaction between himself and the scene (apparently active fruition). Three-dimensional representation, without abdicating fundamental research qualities, can offer user involvement by replicating the real scene. The characteristics that must be maintained are: fast implementation, flexibility, data reliability, and all the critical scientific apparatus we discussed earlier.

Therefore, it was planned to use the 3D of the integrated site survey as an obligatory step of the research method for the three-dimensional visualization of the acquired data and put into the register. The model is taken up, making it the locus of the collected data, different from a repository of storage only. At the same time, it was wanted to avoid element-by-element architectural editing, such as the constitution of objects in BIM software families.

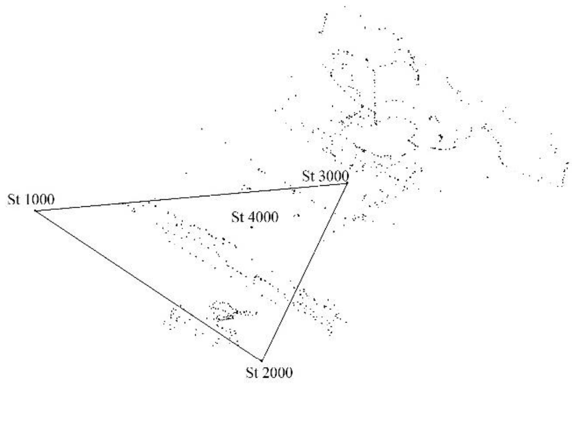

Fig. 5: Cad output of the topographic survey after its registration and control. AskGate Mission 2023

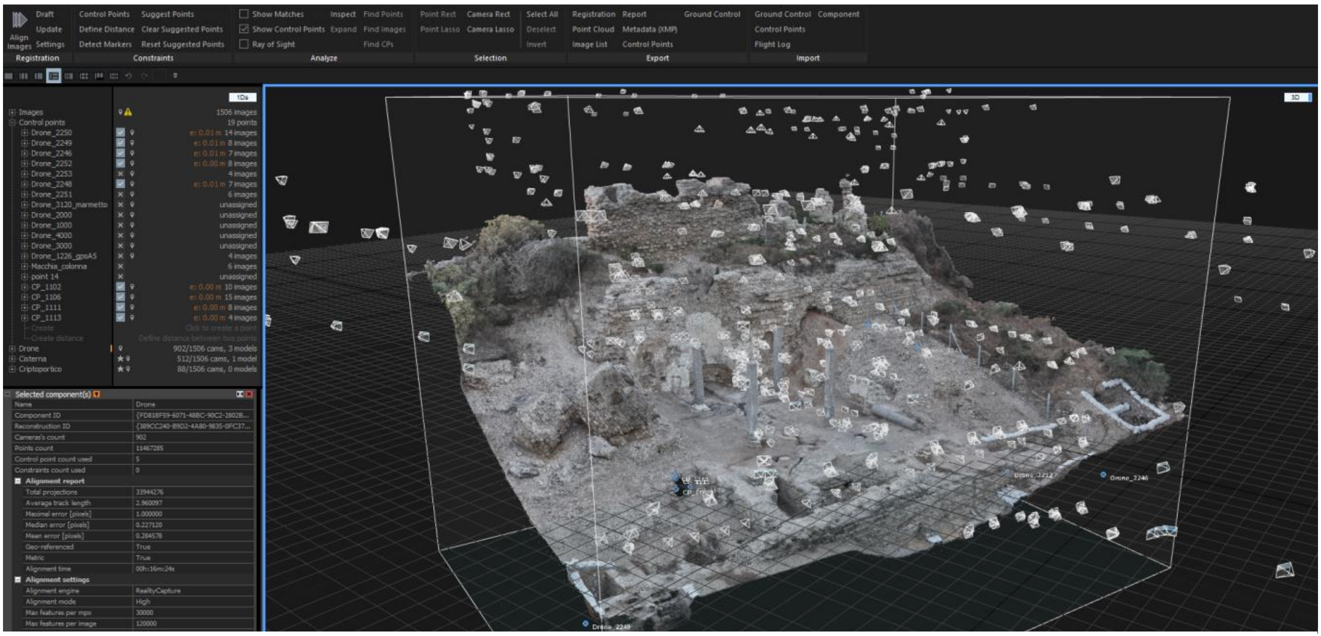

Fig. 6: Setting up the project on RealityCapture software 1.3. AskGate Mission 2023

The 3D model already contains the defined geometric formal characteristics to make it seem unnecessary to reproduce, with approximations for more, the various architectural devices. The choice of the graphics engine was determined by two main factors (Amoruso & Buratti, 2022). The first is free, while the second is to have adaptability and ductility in terms of both content and interfaces. Therefore, the work was developed through UNITY (Yao-An Lee, 2017). The engine's superior prototyping ductility is applicable in both 2D and 3D environments due to its ability to optimize and adapt in 3D rendering, while also guaranteeing metric integrity of the input model.

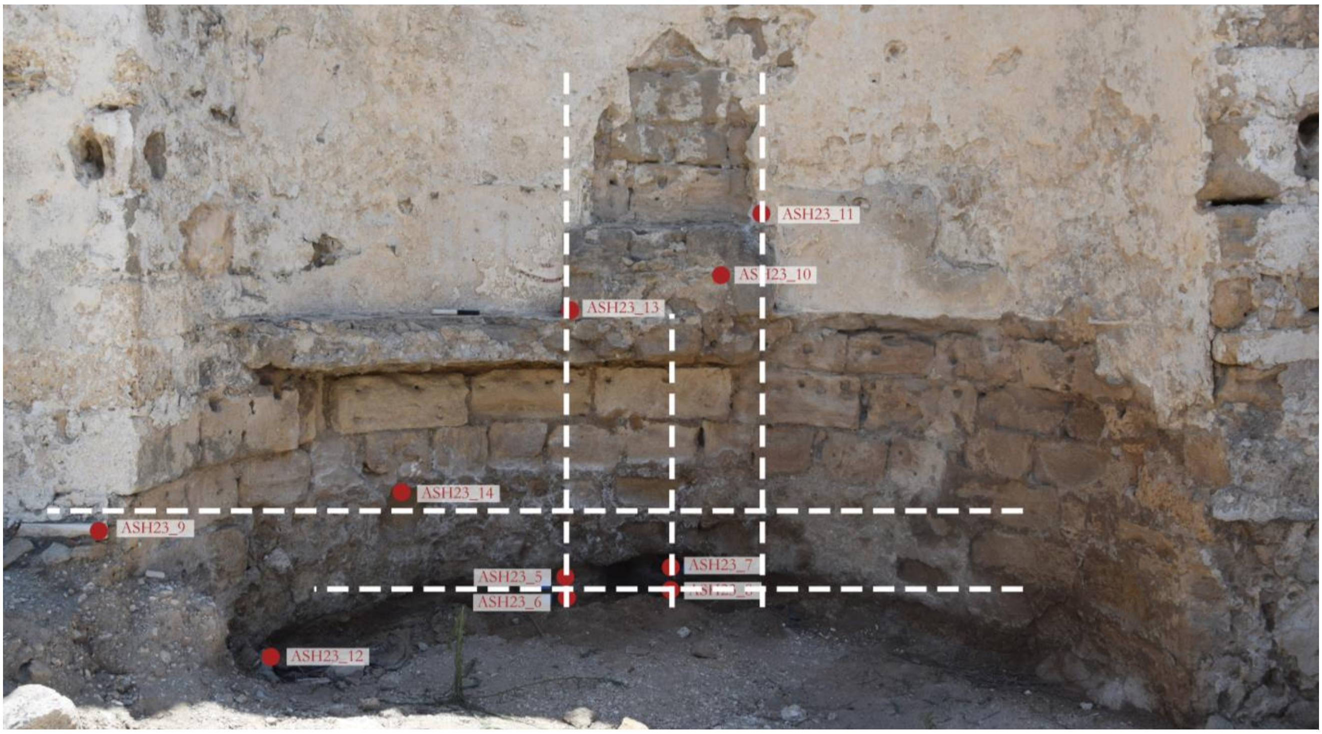

Fig. 7: Systematization of the microarchaeological sampling areas for three-dimensional colocation. AskGate Mission 2023

Considering the time, it takes to build and organize the GARR server space, at the moment the development of the 3D Collecting Data application has taken place only locally, with offline functioning (Vezzi, 2024).

The result of all architectural surveying operations, which we take for given here, is a 3D model with the accepted and ascertained internal error of 1cm in its x, y and z dimensions. In turn, the topographic survey data have to remain within the usual acceptable error range to be coordinated with that of the mesh. As the topographic survey has an higher metric reliability, all error mitigation actions are implemented such as, for example, through the elimination (decimation) of divergent data reported by the matrix output of the translation software (Fig. 5 - 6).

Referring to the micro-archaeological survey, only a specific amount of the data are processed within the 3D model (Fig. 7). All sampling areas were systematized according to both horizontal and vertical alignments as a methodological experiment and placed in the three-dimensional space. The samples, supported by topographic measurements, drawings and context photographs, are located on the plan and in sections in the 2D drawings. All data and related results are spatially captured to inhabit the 3D model. It will be the base from which to coordinate the work of the various disciplines by obtaining a single formal descriptive output that makes the disaggregated data, accessible to the community of researchers.

3. 3D Collecting Data: the architecture of the app

The app, 3D Collecting Data, shows a 3D model explorable through an overview of the archaeological site of Santa Maria in Viridis, with the possibility of having a direct visual comparison of all the scientific data collected, their analysis and their results, coming from the excavation campaigns carried out in Ashkelon in 2022 and 2023 (Vezzi, 2024). Currently the visualization of the available data is concentrated in the apse area (Area 1), as a pilot case for later integration into the other areas being excavated (Area 2, 3, 4, 5, 6).
The contents are divided into images and graphics made ad hoc; photographic data structured in a system of reference galleries regarding general views and details of the excavation areas, archaeological finds and samples for micro archaeology; written text displayed in scientific support of visual content of various types; 3D photogrammetric models related to individual archaeological findings; 3D elements to support the description of the data contained; bibliographical documents.

Through the application realized with the UNITY engine, the visualization of the 3D model of the area is managed, allowing the zoom in, zoom out, rotation and movement on the Cartesian axes.

This has been possible by a rig system, which consists in the possibility of movement of which an element is equipped within a virtual space, this allows to move the view using the mouse: the left button for camera movement and the middle button for zoom, while the movement of the camera on the x and y axes is done via the right click on the mouse. You can also select model-specific orthogonal views such as front, back, left, right, and top.

At the moment, the viewer application, containing all the available data, has been developed for offline use. Later this data will be hosted in the dedicated server space. The update will be carried out by professionals from universities and research centers related to the scientific mission.

3.1 Post production of contents

Once two-dimensional and three-dimensional information to be included in the app are selected, it is necessary to post produce this information and optimize them for the two display modes: on computer and browser, ensuring consultation both offline in local and online on the web.
In both outputs, images and photos have been resized to the functional format to the chosen interface.
The raw 3D models obtained by photogrammetric processing (of the drone and from the ground) produced a territorial spatial model that was

Fig. 8: Optimization work on the model obtained from the photogrammetric survey.

reduced in the area of interest, implementing a first optimization of the polygons of the mesh (Fig. 8) (Luschi & Vezzi, 2023). Areas with vegetation disturbance and metal elements of the site's fence were eliminated.

The model of Santa Maria in Viridis produced for the downloadable offline version, is not substantial decimated in the number of polygons, but mostly retopologized, keeping the texture to the highest possible quality. The latter can have a very high quality because all 3D elements downloaded locally will be accessible and viewable without the use of the internet.

For the browser version, even after the first reduction of the area to the site of interest, the models were still too difficult to load (Merlo et al., 2021). Thus, an additional optimization made possible by the simplify (decimation), retopology and LOD (Level of details) function of Reality Capture has been applied.

he first function allows to reduce the number of polygons by altering the mapping of the same and reprojecting the texture to the highest possible definition on the new polygonal arrangement. The LOD in computer graphic refers to the complexity of 3D model representation: it allows to view different display of the model loading the more detailed version according to the distance of the viewer from the object (García-León at al. 2018).

In addition, further elaborations and measures have been necessary to make the representation of the model pleasant also from an aesthetic point of view.

The 3D model thus becomes a copy of the real that allows the change of scale depending on the observations that anyone wants to realize in the post-excavation.

3.2 User Experience e User Interface

The 3D Collection Data is an app developed for the scientific dissemination of data, analysis and results, viewable through an explorable, three-dimensional representation. It is addressed primarily to an audience of experts in the field, but still accessible and consultable. The English language has been chosen for texts and content because of its internationality, favouring a better understanding in the scientific panorama (Fig. 9).

The 3D viewer comes with an interface characterized on the left by four drop-down menus. The first concerns the choice of the reference study area on which the following actions are then applied in the second, third and fourth. The transparency features of the controls and their graphical display are designed to be less invasive and more coordinated.

This kind of menu is chosen to reduce as much as possible the area occupied on the screen,

Fig. 9: General view of the 3D Collecting Data application.

disabling the selected element to favour a view as free and complete as possible of the 3D model only.

The model itself, with the possibility of movement, is gradually enriched by indicators that characterize and increase its intrinsic readability, focusing the user's attention on punctual areas, circumscribed in the excavation. The right area instead is occupied by a space containing textual information, photo galleries, explanatory images or 3D elements in support of the descriptive actions selected from the left menu, closely linked to the visualization.

The three-dimensional visualization need to use representation codes that can make explicit and intuitive the perception of the information of the data to be communicated. Interesting is therefore the use of a key symbology with which the themes of study treated are distinguished, characterized by a graphic style that is as close as possible to that of a sketch made by hand or on a notebook. We try to make the language of communication more personal and friendly towards the user.

The symbols adopted have an intuitive figurative character that summarizes the contents they represent such as those to recall the studies concerning excavations, those to indicate the analysis and final results of the research. Other symbols will also be attributed to identify more descriptive topics of the compositional and functional system of the architectural structure.

Studies of gestalt and contemporary communication are the base to through the symbolic dimension (iconic) widely consolidated that has entered the visual culture of people, not to confuse the user.

Even the choice of the color palette follows a visual logic by not weighing down the view and not getting confused within the graphical interface, always taking as a base the specialized studies that focus on common visual defects, aiming to an understanding of the symbol. Both icon and symbol are part of the expressiveness of the design and the sign, an issue that will be taken up later.

The interface is also characterized by the graphic indicator of the north that orients itself according to the rotation of the model and in the same way, a metric scale follows the zoom dynamics of the display.

Centrally located between north and scale, the date of the last data update is indicated. A critical issue concerns the management of the virtual light source because historical artifacts are oriented to the true north, not to the magnetic one and that means that the north is shifted from what would be real to the structure. Secondly, all gnomonic openings that can characterize a structure like a church have the problem of latitude, longitude and

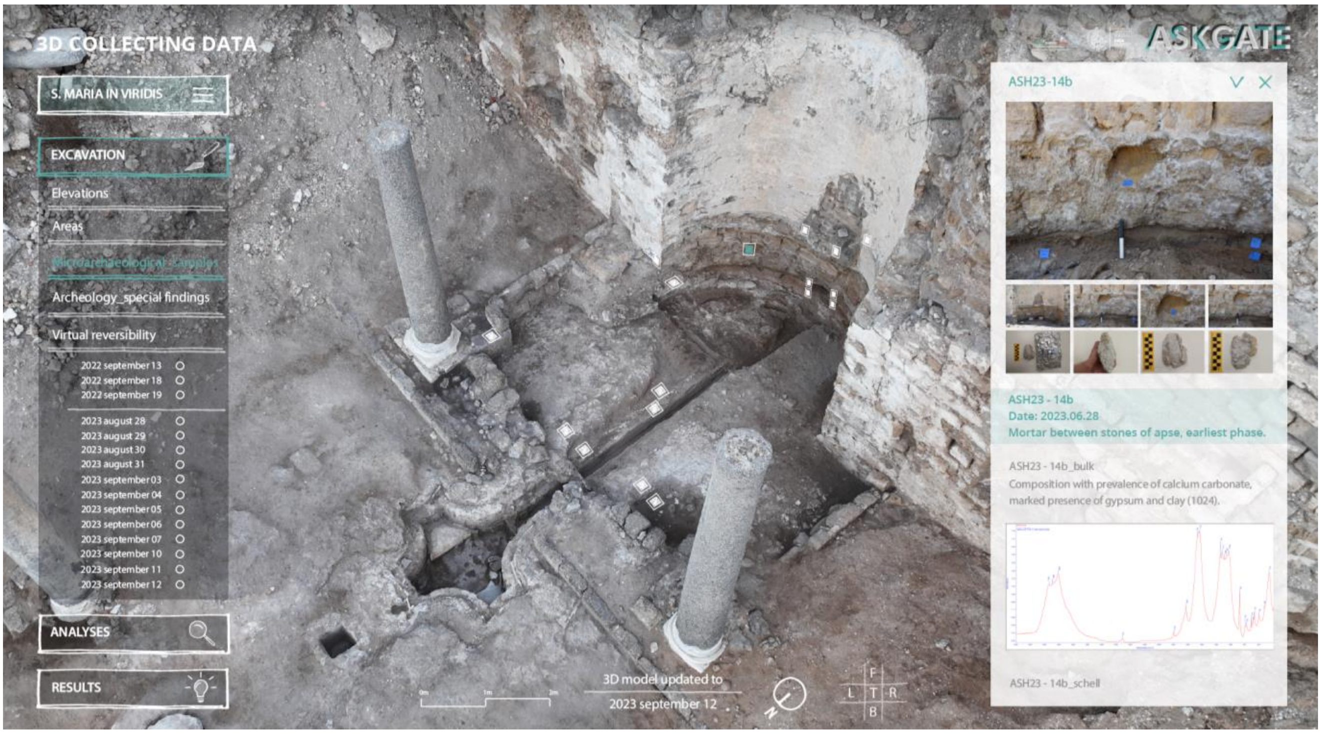

Fig. 10: Micro-archaeological sample visualization interface.

Fig. 11: Special findings visualization interface.

position. For this reason, the rig system that directs light source won't be activated until the work of solar orientation of the site would be carried out.

The menus are divided according to themes that concern all the scientific data collected during the excavation, the subsequent analysis, the description of the architectural structure and the final results obtained.

Inside the excavation menu, in optional ways, it is possible to activate: the fields of the excavation areas, the elevations data, the micro-archaeology

Fig. 12: Masonry stratigraphic units visualization interface.

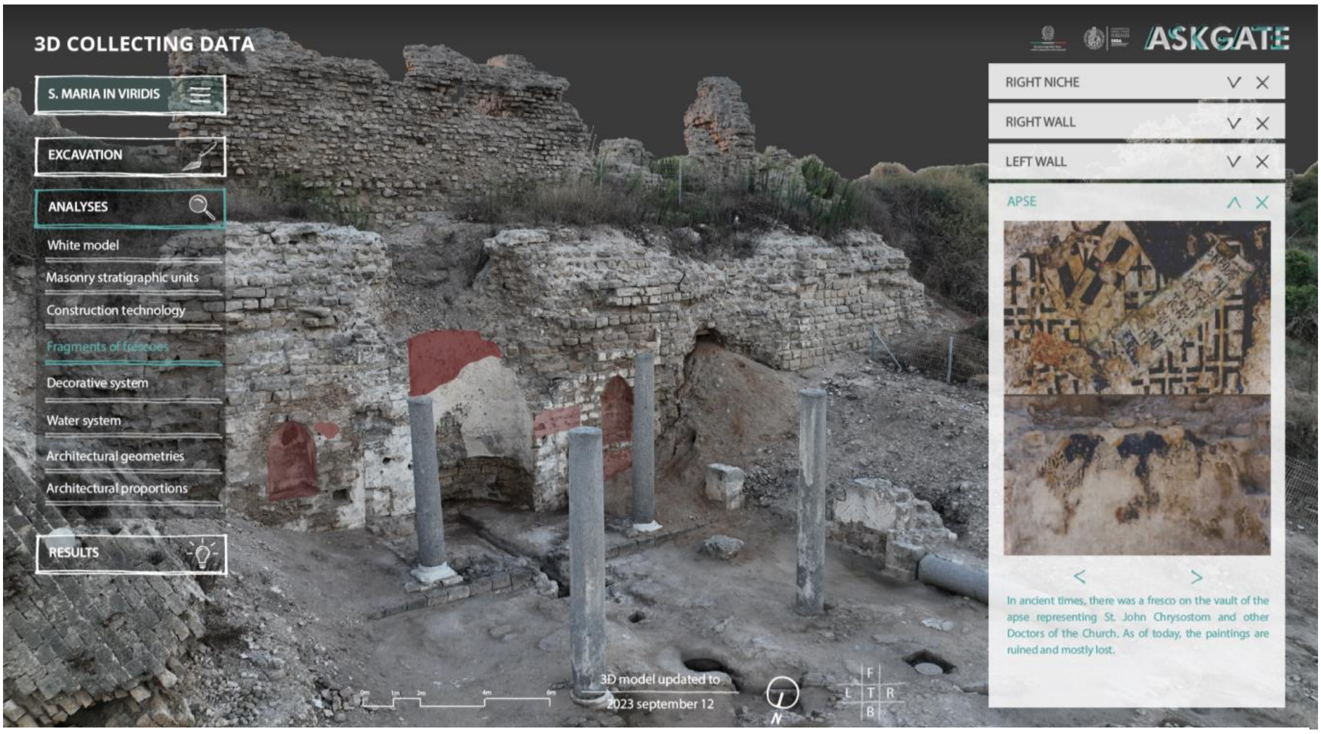

Fig. 13: Pictorial fragments visualization interface.

samples, the archaeology special findings and the virtual reversibility system. The data taken from the samples for micro-archaeological analysis are organized and displayed spatially in the 3D model according to their topographical localization (Fig. 10). The photo gallery testifies to the stages before, after and during the sampling of the elements analyzed. The name and texts support the first studies carried out in the laboratory.

The latter reinforce the description of the samples through technical graphs for an immediate reading of the possible results

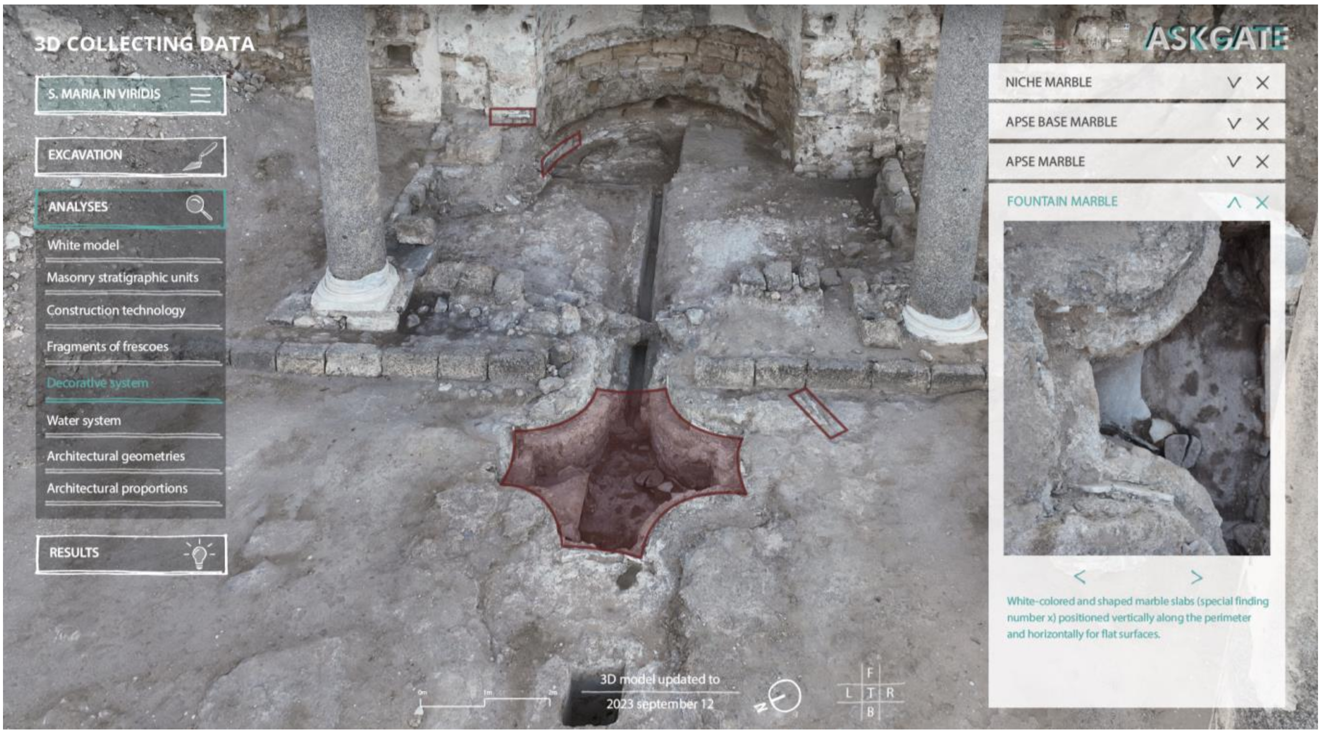

Fig. 14: Decoration system visualization interface.

comparable with those of another nature. All archaeological finds are activated at the same time to have a direct overall view of their location, with no temporal distinction depending on the days in which they were found. Also, in this case each find is provided with name, photo gallery and description. Lastly, through the virtual reversibility it is possible to select a specific excavation day (by year, month, day) corresponding to the 3D modelled excavation area updated to the chosen date (Fig. 11).

The views in which the model is placed are dynamic not only because you move the building virtually, but also because the data markers follow the view setting (billboarding). In any case, all menu elements can be activated and displayed simultaneously in the 3D space depending on the needs and information requested by the user.

Inside the analysis menu there is the possibility to display the model of Santa Maria in Viridis without texture, making the architecture stand out in its total volume. This is followed by the archeometric analysis of the masonry stratigraphic units accompanied by the matrix to represent the temporal succession of the walls construction. (Fig. 12). In addition, masonry samples are analyzed in a standardized area of 1m x 1m, comparing dimensional and compositional data on the analytical topic of walls facades and their construction technology. Inside the analysis it is necessary to highlight the whole system of pictorial fragments that affect the surface of the main facade in the area of the niches, inside the niches themselves and in the upper part of the apse area (Fig. 13).

There are remains of red paintings such as lines, letters and symbols, now in a strong state of decay. Important is to give representativeness to the decorative system that testifies to the diachronicity of the site (Fig. 14).

In the analysis menu you can study the structure from an architectural, geometric and proportional point of view, completing the critical information apparatus.

It will be directly viewable on the 3D model, where the elements considered synchronous and eventual dating obtained from all the critical data obtained are highlighted.

4. *Final consideration and future prospectives*

3D Collecting Data aims to be the document that characterizes various aspects of the structure, respecting its uniqueness and its peculiarity, not claiming to standardize the architectural elements in a system, since these are already identified in the building itself. At the same time all the data necessary for knowledge and useful for the study

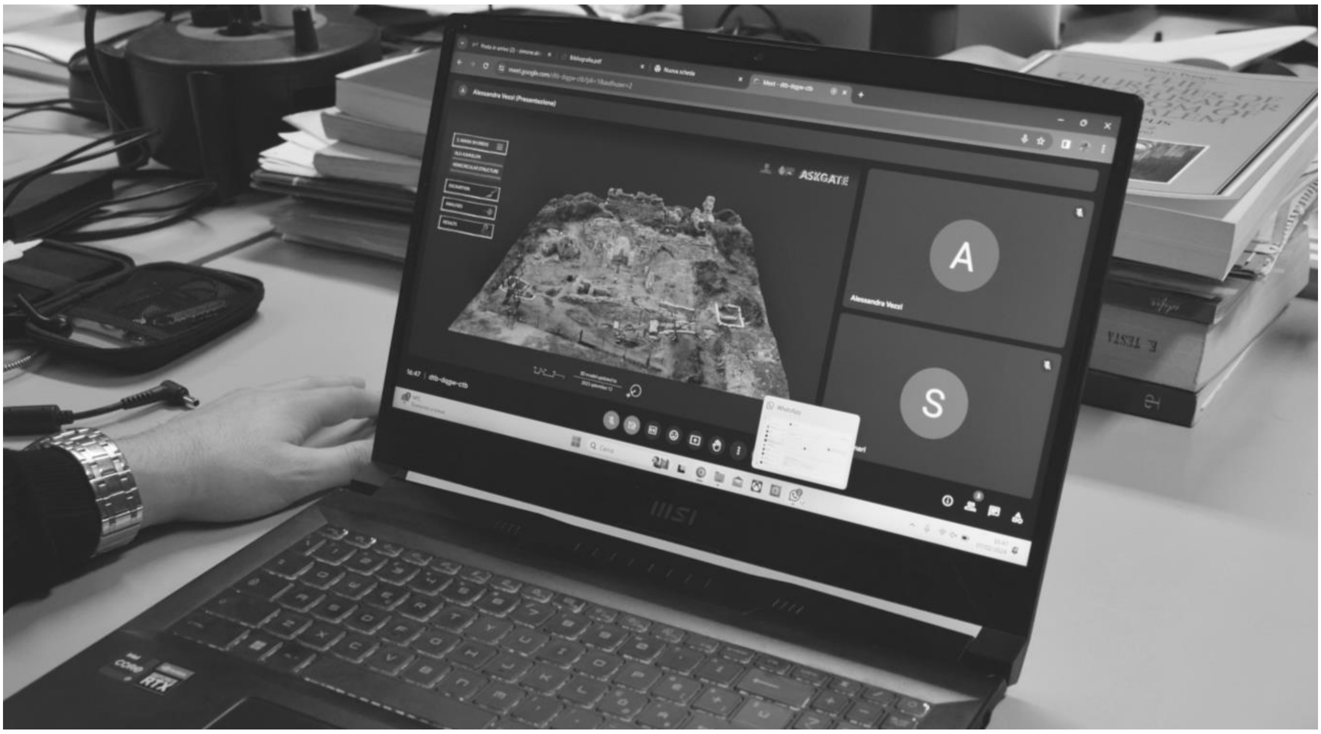

Fig. 15: First test phase of the 3D Collection Data in sharing among multiple users

of the monument, must be checked in the internal protocols of different disciplines.

Once the information is validated for each area, they are acquired by 3D Collecting Data, becoming an integral part of the digital copy and occupying a place within the architectural representation.

It is therefore decided to create a system as flexible as possible and adaptable to the various needs of the site presented to us. However, the aspiration was to expand its potential through the support of GARR (Research Network Extension Management), allowing the storage of information with dedicated AskGate server.

This will allow to have a capacity for continuous updating, thanks to the contribution of the various participants in the research who will have reserved access.

In the future we will want to structure a linked data (Malatesta, 2019; Schmidt ed al., 2022) controlled system within it, so that we can interpret and interrogate the 3D model relative to the different categories of interest. These existing structures would work exclusively using the data contained within the 3D Collecting Data itself, a methodology adopted keeping in mind the rules of restoration specified in the Venice Charter.

In this way the 3D Collecting Data opens up to the scientific community, making all the analyses and results accessible, enabling anyone to analyse the steps investigated and to be able to question the system according to your interests.

The answer obtained will not only be documentary, but also visual directly in the three-dimensional space. For example, to visualize the structural transformations of the building in a certain historical period, the 3D model will activate a chromatic level that will highlight all the interested parts: frescos, mortars, masonry stratigraphic units and masonry techniques. Such that a cultural dimension is provided to the image through visual communication (Fig. 15). The user interface is designed to leave the whole scene to the image.

We try to keep communication as fluid and wide as possible within the working group, but at the same time we aim to achieve a dissemination for an increasingly larger audience taking advantage of that corpus of data, news, documents and models produced by the research itself.

As today, the 3D Collecting Data is offline and locally accessible, promoting its use even in situations of lack of internet, as often happens in archaeological excavations. In any case, the online consultation can still be implemented later.

To conclude, referring to the initial considerations and speaking about interdisciplinarity, the enrichment of the various profiles has been substantiated with a methodological optimization both in the archaeological and microarchaeological fields.

This has created a mutual inference that has been activated from the beginning. For example, in the decisions to choose new areas of excavation in situ, or the production of detailed drawings of samples taken, up to a better contextualization of scientific data: all of them inhabit the space of the 3D model.

5. *Credits*

AskGate Italian Archaeological MAECI Mission (Italian Ministry of Foreign Affairs and International Cooperation).

AskGate Director: Prof. Cecilia Maria Roberta Luschi (University of Florence, Department of Architecture).

AskGate coordinator of the photogrammetric survey with related post-production; communication and dissemination project; graphic design: Alessandra Vezzi (Phd in Architecture, Project, Knowledge and Preservation of Cultural Heritage; University of Florence, Department of Architecture).

AskGate App & AR developer: Federico Niccolai (PhD student in Cultural Heritage Sciences; Florence Academy of Fine Arts and University of Rome Tor Vergata).

* AskGate's 3D Collecting Data application will be presented and exhibited at the OSAKA 2025 World Expo, Italian Pavilion within the Italian AFAM exhibition.

REFERENCES

Amoruso, G., & Buratti, G. (2022). Game engine: valutazione comparativa per una teoria d'utilizzo nel campo del Digital Heritage. In *Dienne. Building Information Modeling, Data & Semantics*, 10, pp. 119-135.

Gabellone, F. (2019). *Archeologia Virtuale. Teoria, tecniche e casi studio.* Lecce: Edizioni Grifo.

García-León, J., Sánchez-Allegue, P., Peña-Velasco, C., Cipriani, L., & Fantini, F. (2018). Interactive Dissemination Of The 3d Model Of A Baroque Altarpiece: A Pipeline From Digital Survey To Game Engines. *SCIRES-IT - SCIentific RESearch and Information Technology*, *8*(2), 59-76. http://dx.doi.org/10.2423/i22394303v8n2p59

Gatto, C., & Semeraro, G. (2024). Digital curation for archaeological heritage: the case study of museo diffuso castello d'Alceste in San Vito dei Normanni. *SCIRES-IT - SCIentific RESearch and Information Technology*, *14*(2), 157-168. http://dx.doi.org/10.2423/i22394303v14n2p157

Hoffman, T. (2019). *Ashkelon 8: The Islamic and Crusader Periods. Final reports of the Leon Levy expedition to Ashkelon*, pp. 33-38. University Park, Pennsylvania: Eisenbrauns.

Laato, S., Xi, N., Spors, V., & Thibault, M., (2024). Making Sense of Reality: A Mapping of Terminology Related to Virtual Reality, Augmented Reality, Mixed Reality, XR and the Metaverse. *Proceedings of the 57th Hawaii International Conference on System Sciences HICSS.*

Lasorella, M., Cantatore, E., & Fatiguso, F. (2021). Smart approaches to enhance technical knowledge of in/low-accessible heritage. *SCIRES-IT - SCIentific RESearch and Information Technology*, *11(*2), 97-112. http://dx.doi.org/10.2423/i22394303v11n2p97

Leone, C., & Perini, C. (2023). Metodologie della ricerca interdisciplinare. Atti della Giornata della Ricerca DIDEC 2022, p. 452. *Mimesis/DIDEC, Sezione Giornate della Ricerca*.

London Charter (2009). The London Charter for the computer-based visualization of cultural heritage (2.1, febbraio 2009). Retrieved from http://www.londoncharter.org/ (ultimo accesso 11 aprile 2025).

López-Menchero, V. M., & Grande, A. (2020). I principi della Carta di Siviglia. In *Atti del XXIII Simposio Internazionale CIPA Heritage Documentation.*

Luschi, C., & Lecci, N. (2023). Virtual Reversibility of the Archaeological Excavation: Santa Maria in Viridis in the Old Ashkelon. In Gil-Piqueras, T., & Rodríguez-Navarro, P. (Eds.), *DISEGNARECON Scientific Jurnal on architectural and archaeological heritage*, 16 (30). University of L'Aquila.

Luschi, C., & Vezzi, A. (2023). Industrial metrological technologies for cultural heritage. *SCIRES-IT - SCIentific RESearch and Information Technology*, *13*(1), 31-40. http://dx.doi.org/10.2423/i22394303v13n1p31

Luschi, C., Lewis, R., Ricci, A., Zerbini, M., Vezzi, A., Lecci, N., & Fichera, A. (2023). AskGate – Studi e ricerche sulla Antica città di Ashkelon 2020-23. *Annuario della scuola archeologica di Atene e delle Missioni Italiane in Oriente.*

Luschi, C., Stefanini, B., & Vezzi, A. (2021). Forma e cultura architettonica dell'antica città di Ashkelon. In *Evolution, journal of life sciences and society*, I, pp. 74-83. Tirana, Albania: Catholic University "Our Lady of Good Counsel".

Malatesta, S. G. (2019). Open Data e patrimonio culturale: lo scenario italiano. In Moscati, P., & Grossi, P (Eds.), *Archeologia e calcolatori*, 30, pp. 451-454. All'Insegna del Giglio.

Mediati, D., & Brandolino, R. G. (2024). Digital Surveying, Augmented Trekking and Valorisation Strategies for Inland Areas. The Grandi Pietre Valley. *SCIRES-IT - SCIentific RESearch and Information Technology*, *14*(1), 79–96. http://dx.doi.org/10.2423/i22394303v14n1p79

Merlo, A., Lavoratti, G., Lazzari, G., Manghi, A., Bartoli, M., (2021). Ghibertiana Project: toward the interpretation centre of the Valdisieve territory. *SCIRES-IT - SCIentific RESearch and Information Technology, 11*(1), pp. 115-132.

Nielsen, J., & Mack, R., (1995). *Usability inspection methods.* New York: Wiley.

Norman, D. A, (1986). Cognitive engineering, in user centered system design. In Norman, D. A, & Draper S. W. (Eds.), *New perspectives on human-computer interaction*. Hillsdale: Erlbaum Associates.

Pietroni, E., & Ferdani, D. (2021). Restauro virtuale e ricostruzione virtuale nel patrimonio culturale: terminologia, metodologie, tecniche di rappresentazione visiva e modelli cognitivi. *Information*, *12*(4). https://doi.org/10.3390/info12040167

Reality Capture, https://rchelp.capturingreality.com/en-US/startIndex.htm.

Reilly, P. (1990). Towards a virtual archaeology. In Rahtz, S. & Lockyear, K. (Eds.), *Computer Applications and Quantitative Methods in Archaeology 1990, BAR* Int. Series 565, pp. 133–139. Oxford: Tempus Reparatum.

Schmidt, S.C., Thiery, F., & Trognitz, M. (2022). Practices of Linked Open Data in Archaeology and Their Realisation in Wikidata. *Digital 2022*, 2, pp. 333–364.

Science Europe (2018). *Symposium Report: Interdisciplinarity* (p. 8). 21 Novembre 2018, Brussels.

Seville principles (2017). The Seville principles on virtual archaeology. (ultimo accesso 20 giugno 2024).

Stager, L. E., Schloen, J. D., & Master, D. M. (2008). *Ashkelon 1: Introduction and Overview (1985–2006)*. Winona Lake, Indiana: Eisenrauns.

Vallet, J. M., De Luca, L., Feillou, M., Guillon, O., & Pierrot-Deseilligny, M. (2012). Un database tridimensionale interattivo applicato alla conservazione di una cappella dipinta. *International Journal of Heritage in the Digital Era*, *1*(2), 233–250. https://doi.org/10.1260/2047-4970.1.2.233

Vezzi, A. (2024). *La santa Maria in Viridis di Ashkelon. I linguaggi della Ricerca.* Tesi di Dottorato di Ricerca in Architettura, progetto, conoscenza e salvaguardia del patrimonio culturale, curriculum in Rilievo e Rappresentazione dell'Architettura e dell'Ambiente, tutor Prof.ssa Cecilia M. R. Luschi, co-tutor Prof. Rafael Y. Lewis.

Yao-An Lee, A. (2017). *A Guide To Capturing and Preparing Photogrammetry For Unity*. Metanaut for The Emerging Media Lab and Department of Geography at the University of British Columbia, UBC Teaching, Learning Enhancement Fund and BCcampus Open Education.