Ways to Cope with the Scientific ARENA: Taking the Results of Archaeological Research a Step Further

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The digitisation of scientific results in ways that make them easy to manage and help to create new knowledge is a requisite. Within archaeology, the relevant activity has focused in digitisation in 2 or 3D of excavations, geographical information, movable and immovable finds and the relative literature. The subsequent data, presented in paper publications, now become also available in off and online repositories.

Within this framework this paper presents the ARENA project (Archaeological REsearch in the North Aegean). Its main theme is the creation of a digital place and time-related repository of archaeological literature. The project aims at the collection, management and presentation of the archaeological research conducted in Aegean Thrace and generally the northern Greek territory. Its goal is the transformation of traditional research into digital archaeology accessible and usable by everyone. A multidisciplinary approach is used, bringing together traditional archaeological research and the use of information and communication technology.

The aim of ARENA is a) to give an integrated perspective to the researchers of Aegean Thrace and to facilitate their work, but also b) to provide the general public (residents, tourists, teachers etc.) with a tool in order to better approach the archaeological knowledge regarding this area.

Through this work the objective is to create different tools and repositories presented through an online platform where 1) the available archaeological publications for the region will be gathered, 2) the ancient sites and the relevant research will be presented following chronological and spatial criteria and 3) the results of the archaeological research will be easily accessible by the public.

The ultimate goal of ARENA is to deliver a digital platform that will serve as an infrastructure tool for the archaeological research in Northern Greece, for specialists and public alike. It will function as a digital hub fulfilling a scientific gap.

INTRODUCTION

> *"It will be a challenging but exciting task to construct and maintain a subject repository for archaeological literature"*
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> [Xia 2011, 246]

This rather concluding remark of Xia seemed an adequate start for this paper. The presented project deals with a relevant effort to create and maintain a digital repository for the archaeological publications and research in the area of the North Aegean in Greece. Thus, this project chose a relevant acronym, "ARENA" (Archaeological REsearch in the North Aegean), which echoes, apart from the subject and geographic interest, its true contribution within the

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archaeological discipline that can easily resemble a true arena. The ARENA project identifies similarly scholars and the general public as its target groups that will benefit from this work.

ARENA[1] is a project launched in 2017, running officially from April 2017 until the end of 2020. However, the actual collection of ARENA's data started from the beginning of 2018. The project will substantially create a digitised collection (constantly enlarging) regarding the archaeological research of Aegean Thrace and Northern Greece during the historic times before the Roman Era and it will open this assemblage to academics and the public. The collection and presentation of the relevant literature will fulfil a scientific gap, while it will contribute to the history and culture of the region. The knowledge generated will be exploited by the research domain, but it will also be accessible to both teachers and the tourism industry as well as to general users.

Thus, ARENA's primary objectives are to facilitate the archaeological research and fill existing gaps. Moreover, in a secondary level, it aims at offering popularized archaeological information to and satisfying the needs of certain groups such as the school community or visiting tourists.

Realizing the necessity for inclusion of other disciplines in the archaeological research, ARENA is a truly multidisciplinary project. Therefore, it takes advantage of the "Information and Communication Technologies'" (ICT) possibilities and the accumulated knowledge from both sides, humanities and information technologies. In order to understand the project itself, it is essential to present the framework it is placed within.

ARENA FRAMEWORK

In general, the work within modern day archaeological research is changing due to various factors such as the crucial contribution of ICT with worldwide capabilities and extensions [Huvila 2018]. Thus, traditional methods (such as the format of publications, the exclusively academic orientation, a library's location etc.) are questioned, the limits are stretched and new potentialities are emerging. Shortcomings, such as the difficult access to publications, the scattered (digital) material that is hard to be handled and organised and the orientation of research that makes the engagement in thought provoking discussion for the general public difficult, are detected and discussed also within ARENA project. The effort to effectively manage a great corpus of archaeological literature, connect it with specific sites, present it interactively online with spatial and chronological features, and with specialists and non-specialists in mind, runs through the entire project and determines its methodology and desired outcomes.

Geographically, the area of interest is the North Aegean covering the part of ancient Thrace now within Greece (Fig. 1). Thus, the Aegean Sea is the south limit (with the islands of Thasos and Samothrace included), the borders with Turkey the east one and the Rhodope Mountains the north one. As for the western limits of ancient Thrace in general, these are harder to pinpoint, because of the constant movement of the numerous Thracian tribes inhabiting the area and the continuous development of the historical and political landscape before and after the formation of the Macedonian Kingdom [Samsaris 1980, 22-26; Pelekides 2000, 99; Tsiafaki 1998, 20; Veligianni-Terzi 2004, 10-13]. Since ancient Thrace at periods reached the area of Pieria (with river Strymon and river Nestos being later limits), this area defines the western limit, even though for a great part of the examined time it was not part of it. Data from the islands of Lesvos and Lemnos will only be considered in a supportive manner. Thus, to sum up, the research zone extends from the Thermaic Gulf until the borders with Turkey, including the coastal area in the Aegean and a part of the hinterland. This is a region where Greek colonies and local settlements co-existed for centuries.

Chronologically, ARENA covers the period from the 8th century BCE, namely from the beginning of the Greek colonization until the end of the Hellenistic era (31 BCE), and thus includes the Iron Age, Geometric, Archaic, Classical and Hellenistic times. This period forms an entity itself with clear distinctions from before and after. It is also of importance for ancient Greek history since it comprises a) the establishment of the Greek colonies in an area already populated, b) their development in significant trade and cultural centres communicating with the rest of the Greek world and the Thracians, and c) the Hellenistic era that faced so many changes in the political and cultural scene and ended up with the emerging Roman empire. At this point the chronological focus of ARENA leaves out the prehistoric and Roman times but the hope is that they may be included in the next project, ARENA+.

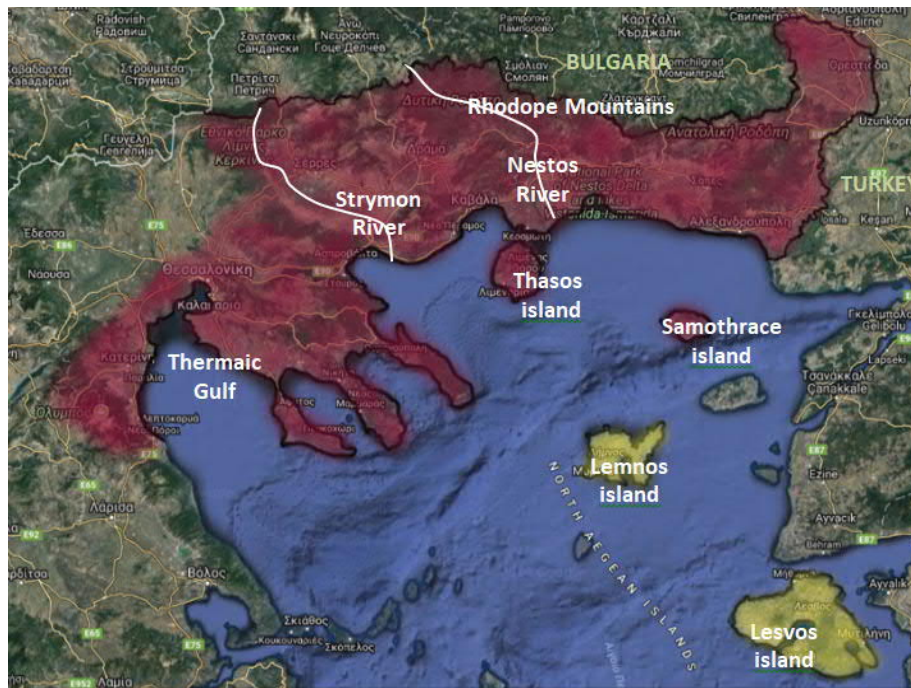[1] http://arena.ipet.gr

Fig. 1. Map of North Greece with the area of interest to the ARENA project marked with bordeaux red and yellow

ARCHAEOLOGICAL RESEARCH IN THE NORTH AEGEAN

In order to understand the need for ARENA, let's briefly see the state of the archaeological research in the area of the North Aegean. That will be done through the presentation of the archaeological aspect and interest of the ARENA project in order to make the need for it and the gap that it comes to fill obvious.

The North Aegean area constitutes an important field of interest in archaeological research, especially during the last decades. After a reset of focus of the archaeological science from the great centres of southern Greece to the often called "periphery" of the Greek world and after some great discoveries especially in the region of Macedonia, the course of archaeological research changed and produces results that question established views [Archibald 2010, 85]. The Archaeological Service along with Universities and Research Centres conduct research and publish their work in the "Archaiologikon Deltion" (ADelt), the publication of the Greek Archaeological Service (with a significant delay though), in articles, monographs and of course in the important annual conference "Archaeological Work in Macedonia and Thrace" (AEMTh) [Gkatzolis 2012].

Another aspect of the archaeological research in the project's area is its connection to an important issue of current scholarship, that concerning the periphery of the ancient Greek world, the fragmentation and the relationship of the ancient Greeks with the "others" [Xydopoulos 2004; 2007]. The ethnographically diverse area of Thrace, expanded over most of south-eastern Balkans, was rich in natural resources that attracted among others, the Greek interest during the Greek colonization (8th-6th cent. BCE) and later on, the interest of powerful city-states, such as Athens, and kingdoms, i.e. the Macedonian. So, the perception of the "Other" for local tribes and the political connections of the latter to the Greek world are issues concerning a great part of the archaeological and historical community and apply in the research of the area.

Thus, the scientific interest for the region appears quite extended, with numerous excavations and research taking place there. Apart from the Greek Archaeological Service and Greek University excavations, other organisations are active in the area. Among the latter are a) the Athens Archaeological Society [Petrakos 1987] and b) the foreign institutions, French School (Thasos, Philippoi), British School (Olynthos), Australian Archaeological Institute (Torone), American School of Classical Studies, through the Princeton University (Stryme) and Emory and New York Universities (Samothrace) etc. [Adam-Veleni 2017, 339]. Some of these present (part of) their current research in websites, along with printed publications, e.g. the website of the American team working in the Sanctuary of the

Great Gods on Samothrace[2] or the website of Olynthos project, a joint project of the Universities of Liverpool and Michigan, under the auspices of the British School at Athens[3]. In these websites selected relative publications are presented as lists, while relevant textual and multimedia information addressed to the general public and the educational community, too, is also presented through these websites but also through printed publications, some of which can be found in digital form in the educational portal of the Greek Ministry of Culture "Follow Odysseus"[4].

This dispersion, in terms of archaeologists coming from different places, has of course beneficial effects, since they apply the most current international archaeological knowledge in the research of the Aegean Thrace [Loukaki 2008, 151-156]. However, this same dispersion, together with the scattering of archaeologically relevant publications among humanities, history and science and along with the special difficulties of the archaeological work, presents some drawbacks for the archaeological research in the area. The continuously growing number of publications, written in various languages, presented in various journals or conferences worldwide are not always known or accessible, while there is not one single institution making them available to the archaeological community and the public. Consequently, the accumulation and presentation of all this research and scholarly work from around the globe, carried out through decades, emerge as a necessity that will fulfil an important gap. Then again, the venture of attempting to organise and promote a relevant subject repository seems entering a scientific *arena*, trying to find ways to cope with it and make it worth meaning for the interested researchers and the general public.

RELEVANT PROJECTS

With the previous thoughts in mind the project's acronym was selected, before another earlier ARENA project came to our attention (Archaeological Records of Europe - Networked Access), dealing also with Archaeology and more specifically with digital access and dissemination of primary archaeological data from excavations and archives from six different European countries [Kenny and Kilbride 2002; 2003]. Relevant projects for the digital management and sharing of excavation data within a specific country or internationally have and are still working on conveying the various formats of primary archaeological data to researchers and the potentially interested public to support research and heritage. ARIADNE (European) project for example [Meghini et al. 2017], gives the ability to the user to browse the catalogue through a map, a timeline and a thematic catalogue, but with very few datasets from Greece. At a national level there is, among others, the work of the Institute of Archaeology of the Czech Academy of Sciences [Kuna et al. 2017], that of the "Archaeological Data Service" (ADS) in the UK [Power et al. 2017], and "the Digital Archaeological Record" (tDAR), the digital repository at Arizona State University in the USA [Watts 2011].

Moreover, ADS hosts the ADS Library[5], a collection holding 295864 bibliographic records coming from the "British and Irish Archaeological Bibliography" (BIAB), the ADS library of unpublished reports as well as documents from the ADS archives and archaeological publishers. In the other side of the Atlantic, the tDAR allows the user to search 383582 documents, see them in map view, in relation to the spatial coverage (but sometimes too generally placed, with the use of i.e. "Europe" as a geographic keyword for a document on a specific site) and also log in and download the results of a research to Excel[6]. Apart from born-digital projects, the gigantic work underway for the publication of the "Bibliographia classica orae septentrionalis Ponti Euxini" (BCOSPE) should be mentioned, which is a remarkable bibliographic achievement for the study of the Ancient History of the Black Sea coast [Cojocaru 2014; 2018].

As for the archaeological literature relevant to the examined region, efforts to present it have already started partly within other projects and publications. But they are not always in digital format or easily accessible. One of the latest publications is the fourth volume in the "Archaeology" series from Melissa publishing house, with "Macedonia and Thrace" as its focus, accompanied with rich and up to date bibliography on the region's major sites [Vlachopoulos and Tsiafaki 2017]. Another publication is the journal "Archaeological Reports" (AR)[7] published by the Society for the Promotion of Hellenic Studies and the British School at Athens, which appears to be the only annual account since 1955 of recent archaeological work in the entire Greece published in English. This periodical edition gathers information mainly from the ADelt, AEMTh conference, the annual accountability presentation of

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[2] https://samothrace.emory.edu/
[3] https://sites.lsa.umich.edu/olynthos-project/
[4] http://followodysseus.culture.gr
[5] http://archaeologydataservice.ac.uk/library/index.xhtml
[6] https://core.tdar.org/search/
[7] https://www.cambridge.org/core/journals/archaeological-reports

the Athens Archaeological Society "To Ergon tes En Athenais Archaiologikes Hetaireias" (Ergon), Greek newspapers and reports from Foreign Schools and other individual scholars [Stamatopoulou 2017].

Another relevant electronic resource is "Archaeology in Greece Online/Chronique des fouilles en ligne" (AGOnline)[8] by the British and French School at Athens, which provides illustrated site-by-site accounts for the whole country, including Northern Greece. AGOnline provides the latest information about current archaeological fieldwork in Greece with site entries mostly drawn from sources like those for the AR [Morgan 2010].

An effort that organises its literature collection according to ancient sites in Greece and the North Aegean specifically and provide, apart from this bibliography list, a summary on the site, too, is the "Art & Archaeology Artifact Browser"[9] of the Perseus Digital Library [Smith and Crane 2001]. Another earlier project is the "Thracian Electronic Thesaurus"[10]. This repository was research oriented and holds 2674 bibliographic records, 25 inscriptions and 2255 ancient written sources, all associated with 850 (ancient till modern) sites in the Greek Thrace [Grammatikopoulou 2000]. The "Regional Guide of Eastern Macedonia and Thrace"[11] can be considered as a sequel of the previous project with the difference that it was more oriented to the general public and the visitors of the area (and consequently its references, too), covering apart from the culture of the area extra themes like "Environment", "Tourism" etc. In the rest of Greece, the "Archaeological Atlas of Crete"[12], an archaeological inventory of sites, integrated with geo-information, bibliography on the sites and statistical data is worth mentioning [Sarris et al. 2008].

Thus, through all these indicative examples it becomes obvious that it is the right time for a project like ARENA, with focus on archaeological literature (the basis of any kind of research) and supported even more by the current interest on and status of the presentation and access of the archaeological work done in Northern Greece.

THE ARENA PROJECT

Within this framework the principal objective of ARENA is the accumulation, management and presentation of the archaeological research conducted in the northern Greek territory. This work aims to form the basis for future content integration i.e. from publications regarding the rest of the Aegean Thrace researched by Turkish colleagues.

The goal of ARENA is the transformation of the traditional research into digital archaeology accessible and usable to everyone. This transformation will take the results of the archaeological research a step further for academics and the general public. ARENA substantially gathers in an online repository and will make accessible through a portal the large corpus of the relevant academic publications. It will also make this list of publications accessible via digital means, including an interactive map and timeline.

The key element for the ARENA project is the archaeological sites. These sites act as the reference point for the literature gathered, along with ancient written sources and inscriptions, which will be also linked with each site. All the sites will be presented online in an interactive map with chronological features connected to it. When ARENA started solely 79 archaeological sites were easily found in the area of interest, while after 18 months of work the list counts 620 sites. The sources used are various, such as collective volumes, monographs regarding a site or a general theme of interest, series regarding a site, conference proceedings (like AEMTh), journal articles local or international (i.e. "ADelt", "Thrakika Chronika", "Bulletin de Correspondance Hellénique"), grey literature (masters or doctoral theses), excavation websites (e.g. Samothrace) etc. So far 4225 bibliographic entries have been gathered in the online repository. They are associated with keywords (ancient site, site category, time frame, population, subject etc.) that help the search ability and will enable further research, they are checked for accuracy and, where available, they are linked with files formatted as Portable Documents (pdf).

ARENA is an interdisciplinary project implemented by archaeologists, historians, museologists, tourist guides, classical philologists and experts in informatics. Since the priority of ARENA is to cover the archaeological demands, the decisions on the technological part have not been completed yet. They will be based on the specifications set by archeology, history and philology and therefore relevant information on the chosen technology will be presented in future papers. As for the archaeologists responsible for registering the bibliographic entries in

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[8] http://www.chronique.efa.gr/index.php/
[9] http://www.perseus.tufts.edu/hopper/artifactBrowser
[10] http://www.xanthi.ilsp.gr/thraki/
[11] http://www.ipet.gr/culturereportalweb/index.php?lang=en
[12] http://digitalcrete.ims.forth.gr/#arch2

the developed repository, they follow the traditional methodology: the bibliographical references of each publication to be recorded are also checked, in order to understand if they are of interest to ARENA. The open source application chosen by the technology experts' team, to act as a basis for the backend digital repository of the bibliography, is EPrints by the University of Southampton (Fig. 2) [Tramboo et al. 2012].
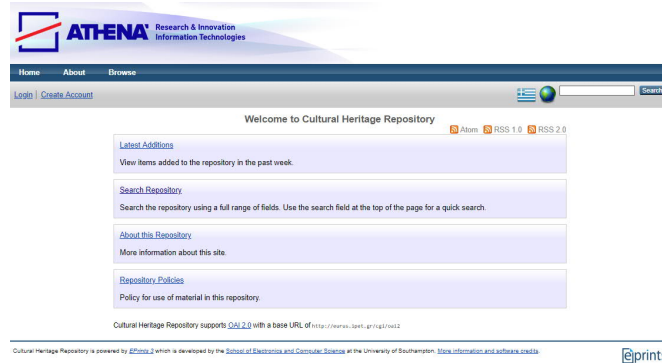

Fig. 2. Screenshot of the literature repository

This repository software also works as the recording tool for the ancient written sources and the inscriptions related to the sites of interest [Loukopoulou et al. 2005]. Material from the "Thracian Electronic Thesaurus", the "Thesaurus Linguae Graecae" (TLG)[13], "The Perseus Catalog"[14] and "SearchCulture"[15] will be gathered and associated with the various sites.

An online gate, using the WordPress capabilities, will be used for the frontend presentation of the gathered content at ARENA project[16]. The users will view and research the archaeological literature, ancient sources or inscriptions accumulated and organised per site. Moreover, their search will be executed with various ways: a) through free text search in the complete content list, with features for sorting available, too, b) through a map view with all the ancient sites marked as spots, collected with the help of digital projects, such as Pleiades[17] and ToposText[18], and with the exact location double checked through the relevant maps in the Catalogue of the Listed Archaeological Sites and Monuments, c) through a timeline view according to the timespan of or recorded events for each ancient settlement, or d) through combined features.

The available information per site will include, for the general public seen as potential visitors, a summary text (prepared for non-specialists), information for actual visits to the site (if this is possible), a list of the literature and multimedia material (photographs, drawings, 3D models etc.). Another target group using the ARENA portal could be the educational community, especially teachers and pupils living, working in or being related to this geographical region. Special consideration will be given for these users, with resources gathered and prepared by archaeologists of the ARENA team who are also museologists, tourist guides and public-school teachers. The interested members of the school community will find a selection of the most important archaeological sites documented in a way satisfying the needs of the school curriculum and of a school visit. This documentation will gather a standard set of material for each site comprising of a relevant plan with the main spots of interest and a proposed route, related photographs, videos, reconstructions, a basic timeline, educational material, the literature and practical information such as opening hours of the sites, contact details etc. This set of material is considered to be prepared not only for the most known sites, but also for others less known, in order for the schools to become acquainted with them. Consequently, this popularization effort of the archaeological research may be of help also for tourists and locals.

Lastly, since a primary goal of ARENA is to become a vivid source of information on the archaeological research of the region, the participation of scholars who work and are involved with the work done in the area plays an important role. Therefore, professionals of the related fields will be able (or invited) to register and become members of ARENA. They will access (apart from the previous) a more analytical text and the full literature list

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[13] http://stephanus.tlg.uci.edu/
[14] http://catalog.perseus.org/
[15] https://www.searchculture.gr/
[16] http://arena.ipet.gr
[17] https://pleiades.stoa.org/
[18] https://topostext.org/

with links to files, where available, as well as links to the associated ancient written sources and inscriptions, all spatially and chronologically associated. These users will be also able to contribute to the ARENA repositories with material, thus continually evolving ARENA.

CONCLUSIONS

After this brief description of the principal philosophy and functionalities of ARENA repository and gate, the following elements have to be underlined: 1) The ARENA project substitutes an important digital corpus of a diverse and sizable archaeological literature, with publications from the 19th century onwards, collecting potentially all references for the archaeology of Aegean Thrace and for the periods between 8th century to 31 BCE, along with the digital files of the actual publications (where available). In this way, ARENA goes beyond the accumulation and presentation of a static and indicative only literature list, with only the latest publications per archaeological site, as done in other relevant projects. 2) ARENA makes use of digital maps and organizes the content gathered per site, checking and correcting misplacements, making use of digitally published maps in official acts and documents of the Greek state and taking literature lists a step further, as for their completeness but also their geographic distribution, viewing and sorting. 3) ARENA tries to create an active community of users interested in the archaeology of Aegean Thrace, with access to the content gathered and eventual user generated additions to the repository, even after the completion of the project. This community will certainly help for the dissemination of the project in the worldwide academic society and for the multiplication of the benefits that ARENA offers. 4) Apart from the scientific world, ARENA considers the general public that would be interested in the archaeological sites and literature of the specific area and time frame and incorporates content suitable for locals, visitors, schools. The project offers not a virtual visit to the sites or touristic information only, but instead the necessary guiding material to assist the actual visit at least to some of these sites. 5) Last, ARENA puts a peripheral area of the ancient Greek world and archaeology into the modern era of digital archaeology.

Thus, the ARENA project through its multidisciplinary approach transforms the traditional archaeological research into digital archaeology and places it within the framework of the current international research. ARENA aims to act as a benchmark tool for the research of Aegean Thrace's archaeology, providing an open and easy to access repository of the academic publications. This platform, maintained by the "Athena" Research Centre, will be enriched even after the completion of the project by user-generated content and participation of scholars that will become members of the ARENA community and contribute to it (potentially in the future even for literature regarding other periods of the whole of Aegean Thrace). In such a way it will function as a vivid digital hub and source of information for the archaeological activity in the area.

ACKNOWLEDGEMENTS

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Masada, the Desert Fortress. Discovering the Archaeological Site by Gaming

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In the last decades the interest in the use of serious games as learning tools has grown and the awareness of how the game is effective in the transfer of information from the object to the user is consolidated. The paper discusses the possibilities that this type of tool offers in terms of learning and dissemination of Cultural Heritage. Through the consolidated methodologies of survey and representation, the key points are highlighted for the realization of an interactive 3D model that can be used through 'playable' modalities. The interaction between the information contents and the visualization tools required a reflection on the quality of the graphic system and the virtual design. Everything must be designed to be an expression of an effective graphic language, starting from the narrative plot up to the rules of the game and the scenario. Special attention is given to the creation of the graphic interface, the buttons, the layout, and the color palette. A possible game platform designed about the Masada fortress in Israel is still developing and, as well as representing an instrument for sharing Cultural Heritage, supports the conservation of artifacts; at the same time it allows to know and protect the intangible assets that make up the identity of the places represented.

INTRODUCTION

This paper is focused the theme of the access to Cultural Heritage through the most recent digital technologies developed in recent decades. The entertainment industry in general, and more specifically that concerning videogames, is now considered the most promising in order to bridge the gap, generated by the contemporary, between those who 'create' or preserve the Heritage and those who enjoy it. For this reason, a particular study is dedicated to the theme of serious games, a potential tool for the re-appropriation of museum spaces and all those places that no longer arouse the spontaneous interest of people.

Today there is a clear need to preserve the Heritage from the test of time in order to ensure the preservation of the 'memory'. The museum structures, together with all the disciplines that regulate its functioning, have available 'new tools' to reach these purposes [Tramontana 2007]. The potential of the most innovative technological systems and their use within museums, both real and virtual, can be exploited [Solima 2011].

The disciplines of survey and representation in the current digital age have in turn become digital and the tools they use are developed hand in hand with technological innovation. Representation models are increasingly used in 3D models, even if they are constantly supported by traditional graphic systems [Remondino 2011].

3D models as well as providing design support are important for permanently recording the shape of existing architectural works and artifacts, in order to achieve the future generations. The 3D model therefore becomes an important 'tool' of the discipline of representation, useful for the construction of virtual scenarios for the use of the Heritage [Guidi et al. 2005].

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This work concerns the complex case study of the archaeological site of Masada in Israel, under UNESCO protection, and the construction of the digital archive obtained through the use of integrated digital survey methodologies and 3D modeling.

The research presented aims at the definition of a methodological process that, starting from a digital database, rich in information obtained by archival research, photographic and digital survey campaigns, allows to 'translate' this data and these 'materials' in contents accessible and usable by the general public. For this reason within this research a serious game called 'Masada Museum' was designed and partially developed as a potential tool in order to increase the potentiality of the current museum structure.

BACKGROUND

The first 'classic contemporary' publication about "play" is the essay entitled *Homo Ludens* by the historian Johan Huizinga which defines "play" as a 'propeller of art' and of all human activities from which culture is developed in all its different forms [Huizinga 1949]. Next to the *homo faber*, who creates and transforms things according to his needs, there is the *homo ludens*. After Huizinga, other scholars have defined the concept of 'play' and have described its dynamics, such as Roger Callois in his essay *The Game and the Men* of 1958 [Callois 2014].

According to Chris Crawford, a computer game designer who incorporates some theories expressed earlier, the concept of 'play' is linked to the 'art' one: the artist in the strict sense of the term usually creates a work or an experience that the public meet directly, while for the game the artist creates the conditions and the rules but it is the public himself who creates his own personal experience. Games unlike other forms of entertainment such as cinema, theater and reading books can be defined as 'participatory', where the player can create the story through the consequences of his actions. A story usually unfolds in a linear way through immutable cause-effect relationships and is meant to be 'experienced' only once, whereas a game with its own multi-pronged narrative structure [Crawford 1984] becomes a multi-purpose experience because it is possible to choose different 'branches'. The advantage of an interactive and participatory representation of video games allows the exploration of all parts and aspects of a story.

The role played by the game designer today is that of a real 'artist' able to identify and deduce the moves of a possible player, his expectations regarding the storytelling and the graphics, so as to create credible 'twists' that provide the player with an unexpected and unusual experience. In this regard Crawford affirms that

> *"...computer games are much like candy, comic books, and cartoons. All four activities provide intense or exaggerated experiences. Whether they use sugar, exclamation points, or animated explosions, the goal is the same: to provide extreme experiences..."*

[Crawford 1984].

Interaction plays a crucial role for the success in creating these sensations because it allows the player to feel an active part of the storytelling and the computer screen, in the case of video games, becomes a sort of space for experimentation and innovation.

Video games can be considered the heirs of the popular arts, "one as appropriate for the digital age as those earlier media were for the machine age" [Jenkins 2005], are lively art that has the ability to provoke strong and immediate reactions [Seldes 1957].

During the 20th century, many scholars have discussed the concept of 'game' and all aspects related to it, have described the characteristics of different video games and have been classified according to specific criteria but have never been formulated formal definitions.

A definition of the Italian dictionary (Treccani[1]) defines the 'game' as any freely chosen activity to which children or adults are dedicated, individually or in groups, without any other immediate purpose than recreation and leisure; physical, manual and intellectual capacities are developed and practiced at the same time. This definition suggests that the player influences the result with his own abilities and at the same time consolidates or develops new ones. This awareness of the player to play an active and dynamic role in the development of the storytelling and the possibility of acquiring new skills and being able to exploit them in the game itself, emerges strongly also in video

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[1] http://www.treccani.it/vocabolario/gioco/

games. These therefore represent a medium of great relevance in the digital era and can be exploited even in non-entertainment fields, overcoming the 'cultural' obstacle that the videogame is an enemy of education and learning, and also an element distraction from traditional activities.

The historical studies on serious games, such as those on games, has not followed a consistent linear path of legitimization, but instead moves in stops and starts [Wilkinson 2016] and the research was based mainly on studies of social sciences, psychology and information technology. Digital technologies today offer more representative possibilities than traditional systems and digital games represent a field of experimentation and innovation for the contemporary world [Jenkins 2005].

The games have always occupied a special place in the minds of intellectuals and scholars and serious games, despite some sporadic uses for learning and training, have only become established since the 21st century. Serious games with their interdisciplinary nature and being inter-contextual provide a wide field of research for the development of tools and systems for the dissemination of Cultural Heritage (Fig.1). However, having an interdisciplinary character and being often the subject of temporary interest by 'amateurs', the definition of the notion of serious game and their integration with the theories of learning and representation has found difficulties.

The term 'serious game' was coined by Clark Abt, developer of military computer games, who describes them analyzing that

> *"...we are concerned with serious games in the sense that these games have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement."*

[Abt 1970]

When Abt wrote his theories, many war-games had already been published and according to him [Abt 1970] serious games are an extension of the previous simulation-based learning approach, a practice strongly supported by Richard D. Duke [1974].

Despite the technological development of the last decades and the awareness of the last few years of how video games can be considered a powerful tool for conservation but also for communication and the dissemination of Cultural Heritage, there are still very few experiences and experimentations in this direction, both from the scientific community and the 'insiders'. The serious game is a tool that can be useful to museum institutions in order to create thematic paths full of participatory and interactive content, which arouse curiosity towards the museums themselves and their contents, and more generally the awareness towards the Heritage. The combination of technological tools, such as those used for "Augmented Reality" (AR) and "Virtual Reality" (VR) is able to create experiences for the exploration of the Heritage of great emotional impact, suitable at the same time to perform functions for cognitive development.
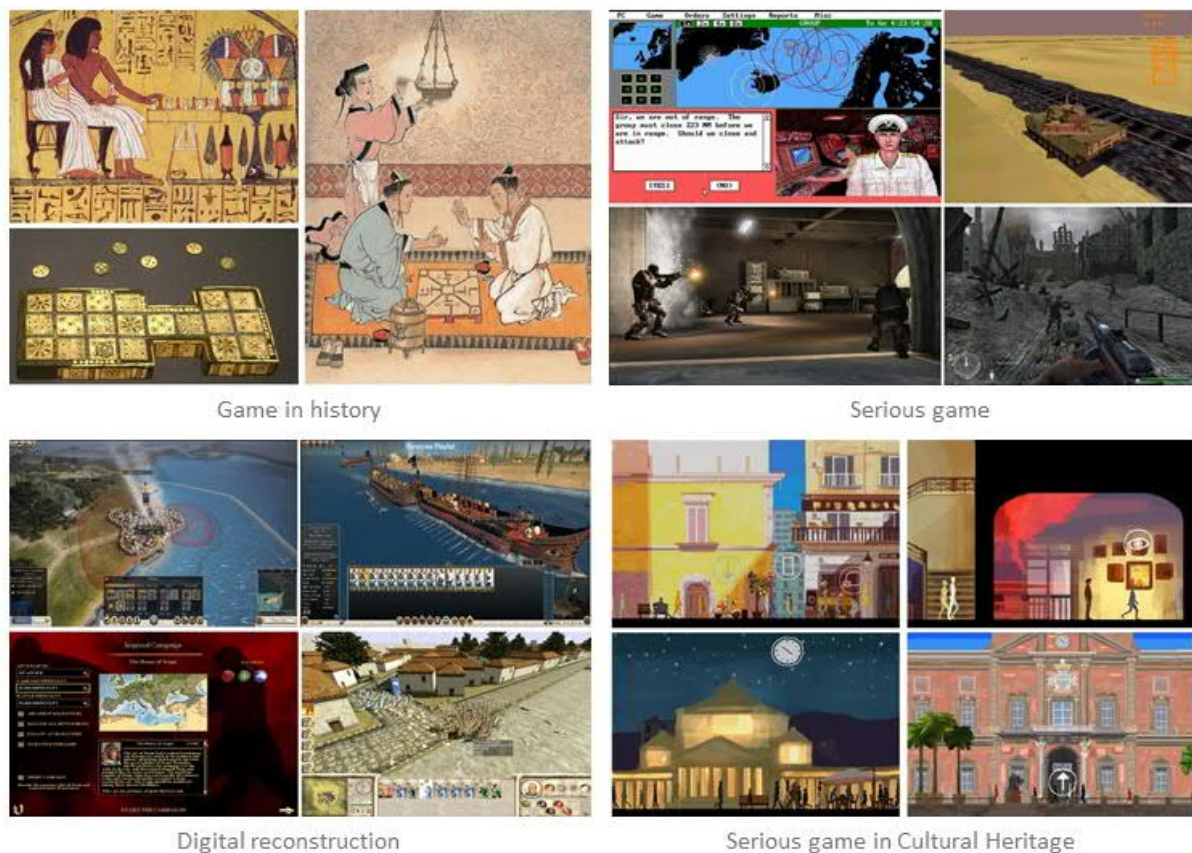
Fig. 1. Representations of ancient games (top left), examples of serious games in the military and cultural fields, and examples of digital reconstruction of historical scenarios

MASADA: THE CASE STUDY

The research project is about the digital documentation of the archeological site of Masada[2] in Israel, which was conducted in accordance with the heritage sites management rules of UNESCO, with the agreement of Israel "Nature and Parks Authority" (NPA). The research[3] took place during four years of international missions in which professors and researchers from the Italian Universities of Florence and Pavia participated, in collaboration with the Shenkar college of Ramat Gan (Tel Aviv), and the results were made available to the NPA in the form of a digital document to support the development of the site's 'management plan'.

The work represents the first complete digital documentation of the current state of the site and demonstrates the possibility of using advanced digital technologies in conditions of extreme environmental difficulty, as the orographic and morphological nature of the site presents terrain unevenness of over three hundred meters and inaccessible mountains sides. Thus, the use of Laser Scanners with 300 m range and "Structure from Motion" (SfM) terrestrial and middle-range photogrammetry methods has permitted the realization of the photogrammetric survey of the inaccessible slopes. Each participating university developed research guidelines; specifically the Florence department has aimed at creating interactive multimedia functional to the tourism promotion of the archaeological park.

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[2] For further information please refer to [Netzer 1991; Yadin 1968].

[3] In 2013, 2014 and 2015 survey campaigns were directed by a team of professors from Italy, Stefano Bertocci (University of Florence) and Sandro Parrinello (University of Pavia), and from Israel, Rebeka Vital (Shenkar College of Tel Aviv). In 2016 the campaign was directed by Stefano Bertocci and was coordinated by Monica Bercigli. (University of Florence). For further information please refer to [Bertocci et al. 2013; 2014].

The technological progress in the field of archaeological survey – where the use of digital techniques is now strengthened (from organization and acquisition of data to post-production) – involves a series of consequences, the most significant of which appears to be the increase in the amount of data and of acquired information. This consequence leads to the ability to develop new documentation and dissemination strategies in order to obtain the best results from the digital potential (Fig.2).

For system consistency but also for convenience in terms of space and time costs all these results must be organize in a tidy system, which needs to comply with the digital tools in order to organize open systems for conserving and disclosing information and, above all, to contribute to the preservation of an archaeological site that is truly a part of the human heritage.

Since 2007 the Masada Visitor Center, located at the foot of the cliff on the east side, holds a museum that exhibits the findings found during the excavations executed by Yigael Yadin between 1963 and 1965. The museum (Fig. 3), in addition to the traditional display cases and information panels, reproduces scenes through representations and real-scale reconstructions of places and people, accompanied by evocative sounds and illuminating from time to time what illustrates the narrating voice.

This theatrical approach aimed at recreating the atmospheres of the different 'occupations' of the Masada site, makes the museum visit 'immersive' so as to entertain the visitor through both visual and auditory sensations. In the museum are reproduced nine scenes concerning the period of Herod, the period of the Zealots and the Romans one. The archaeological finds exhibited are portions of original frescoes and columns of the Palazzo Nord and parts of the floor of the Palazzo West etc.
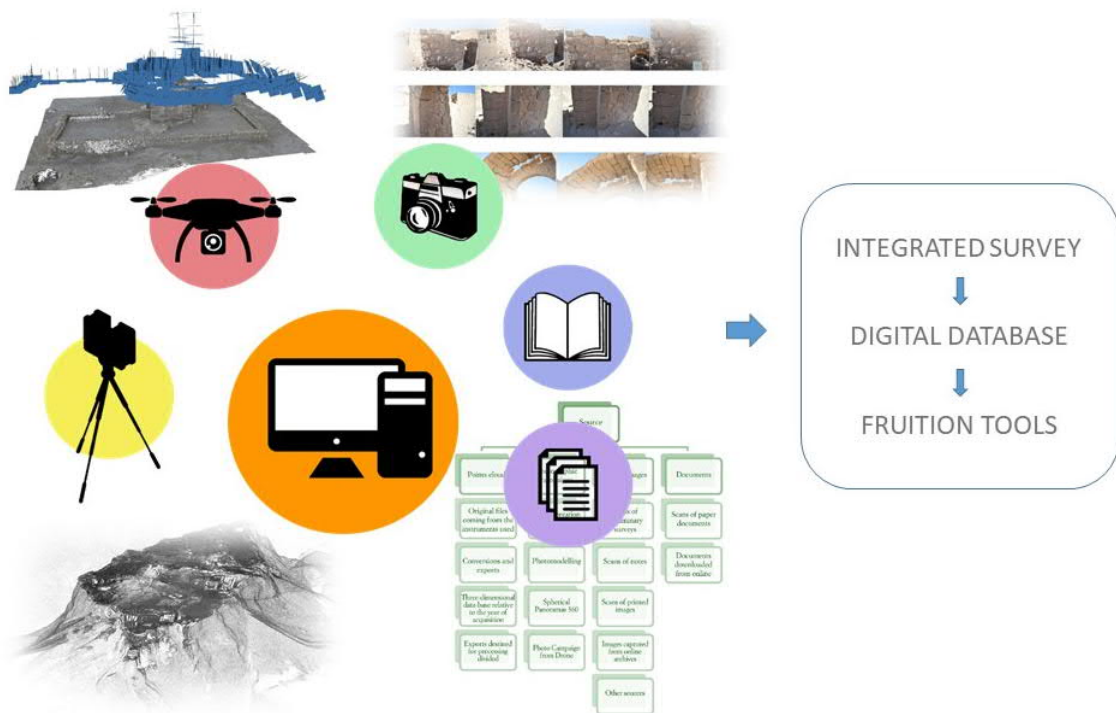

Fig. 2. The scheme summarizes the different types of tools used in digital surveying and the types of output that are generally produced. The challenge is to define a workflow and a useful tool for sharing this digital database

Fig. 3. The Visitor Centre at the foot of the mountain and two rooms of the Masada Museum

A useful tool for the museum both for on-site and remote viewing can certainly be the videogame for all the reasons previously described, starting from the greater involvement of visitors up to the possibilities of cognitive development of children. The museum experience is made more pleasant and the use of the heritage in general is made more accessible through the use of games, able to 'attract' visitors and introduce them in unfamiliar subjects.

MASADA MUSEUM VIDEOGAME

The video game designed and still under development is a single-player type and is only playable by one person. It is possible to share the results in a general ranking with other users, but there is no interaction during the game. The character during the game is related only to some characters in the video game, with which they interact through predefined dialogues that help the player to understand the game plot (Fig.4).

The game is based on a prize-reward progress system where through mini-games and the resolution of the puzzle successive levels are unlocked and are awarded with prizes and points. The 'challenge' factor thus becomes fundamental to make the game attractive and to keep running the interest in exploration and knowledge. The game consists in impersonating the figure of the 'curator' of the museum of Masada who has to set up the permanent exhibition about the history of the site. The game takes place mainly in two places, i.e. the virtual environment of the museum and the plateau of the site, where the character has to go to find the objects. The exhibition rooms of the museum correspond to the four main stages of the history of Masada: Herod's stage, Zealots stage, Romans stage and Byzantine stage.

Fig. 4. The first interaction scene between the Director of the Masada Museum and the curator character

The visualization of the museum rooms takes place by 2D top-down views and by 3D views with the possibility of exploring the virtual museum with an avatar. In this case the course of the game is linear because it is not possible to place freely the objects found in the rooms, but it is necessary to follow the correct historical progress of the different stages.

It is possible to define the part of the game set at the plateau as open-ended (or sandbox) so that the course of the game is not linear and the player is free to perform his preferred actions without following a mandatory plot. The narrative structure of the game is nonbinding for the development of the plot and a player in this way can 'build' his knowledge without constraints.

The player has a map that shows the constructive situation of the phase related to the research objects and can interact with it by choosing to explore different representative buildings. After choosing a building general information is provided and the player can start the exploration with the avatar in 3D models.

The research of the objects is supported by another small map that shows the playing area and the position of the avatar, and a radar that provides an indication of the objects position, thus encouraging the exploration of the places (Fig. 5).When the player is in the immediate vicinity of these objects and interacts with them, the interface of the respective mini-games is activated.

Fig. 5. Videogame scene with an interactive object within the 3D model

There are three types of mini-games: puzzle, memory, and quiz, which can be found within the game several times, performed for different objects and at a different difficulty levels. The structure of the mini-games is well defined and applies the 'always win' approach where the player wins and collects the object located. On completion of the collection of objects and after their placement in the various rooms, a video illustrates the main events and describes the historical and architectural features, thus adding an additional component for the knowledge of information. The aim of the game is to collect all the objects and complete the museums exhibition, thus assuming the role of 'curator' of the Masada Museum.

DIGITAL DATABASE AND GAME CONTENTS

An important step in the creation of the videogame is the visual design phase, the choice of video game graphics, the definition of the interface, etc., but also the content. In this regard there are several specialists who work within the 'chain' of the creation of video games, such as 3D builder, 2D artist, 3D character builder, 3D character animator etc., and that deals with the creation of all the virtual content.

In order to realize a serious game, however, it is necessary to take into account the communication aspects of the information and how to gain effective and captivating content from the digital database. It is essential to study the historical sources and to have a clear understanding of the structure of the storyboard and of the plot for a correct exposition of the peculiar contents.

The greatest difficulties are the 'simplification' of the amount of data collected during the survey and post-production phases together with the complexity of the archaeological site's history and the interpretation issues concerning some buildings that have not yet been completely solved. The procedures used to 'transform' information and data from the digital survey and documentation into game content are here summarized (Fig.6).
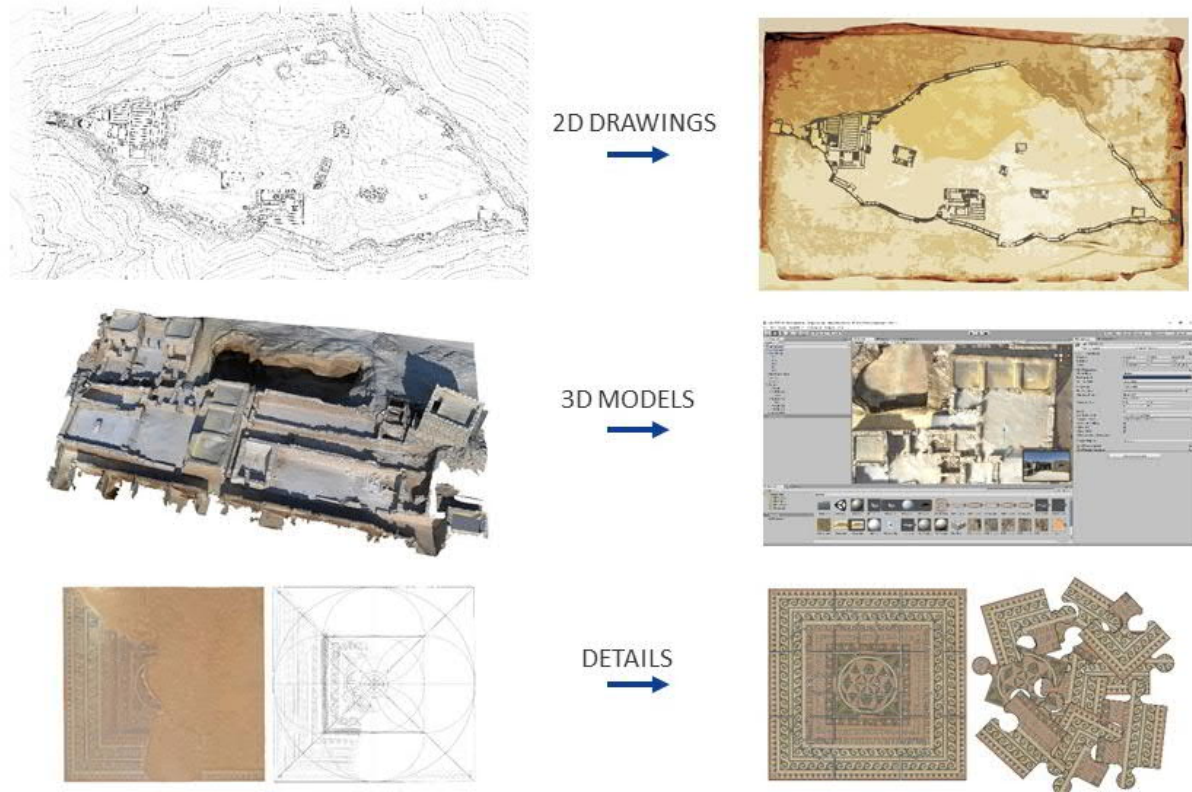
Fig. 6. From digital database to game content. Examples of how to use 2D drawings as map, 3D model as scenarios and detailed element for mini-game

The 2D planimetry obtained from the digital survey has been used as a basis to realize the maps of the game, and it can be useful for the realization of a location-based game. Modern cartography allows the placement of objects to be searched in precise and exact positions and the localization of the user and the objects through satellite positioning via GPS. The 2D drawings of the buildings were used as a basis for the 3D model reconstructions (Fig. 7), for the study of the elevations in their original size, and for the study of architectural typologies.

For the environment of the game, in order to reconstruct the area around Masada plateau, *contourlinemaps* were used, and then the various other models were placed. A multiscale and multi-resolution model has been created, that is a model made up of different parts with a different level of detail of the polygonal meshes.

3D models of the game's main environments have been realized, using the integration of data coming from laser scanners and SfM techniques so as to obtain a complete model in every part and equipped with photorealistic textures. Further detailed models have been realized and concern all the parts the player is interacting with at a close range and therefore require greater accuracy and at the same time an optimal graphic quality.

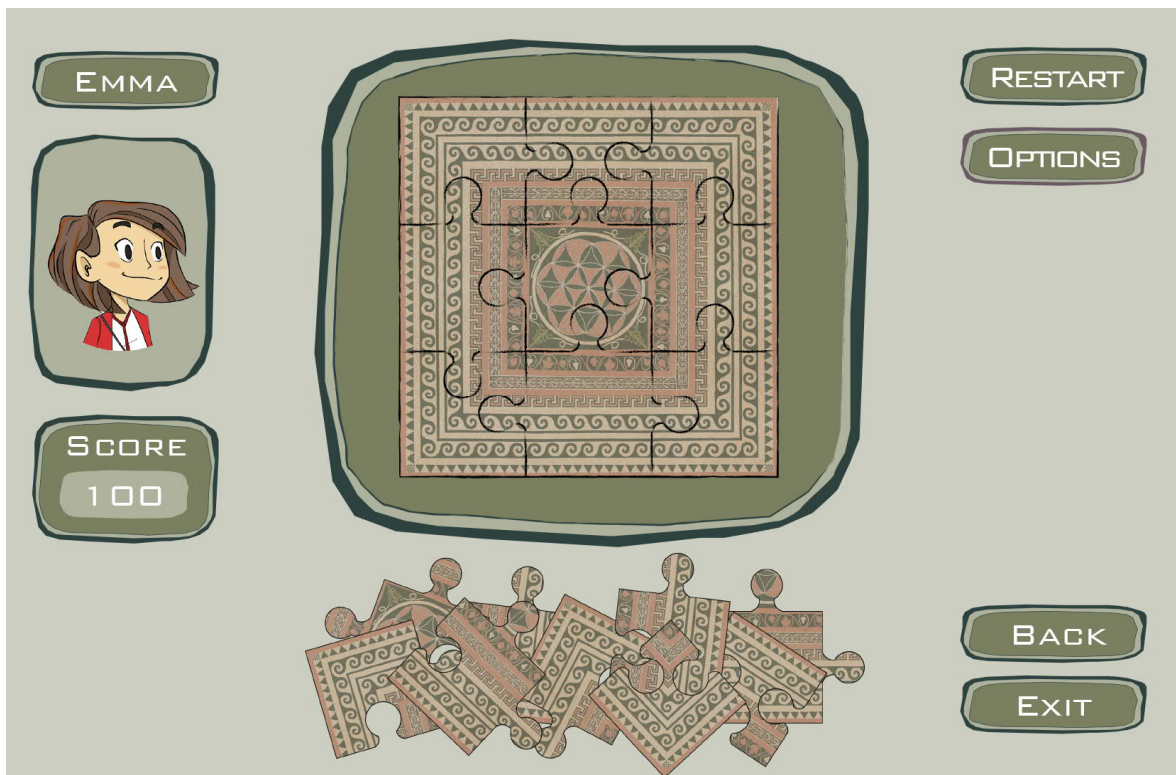*Fig. 7. Example of virtual reconstruction of the Large Bath House*

Fig. 8 Example of a puzzle mini-game

At the end the contents of the mini-games were realized taking into account the objects presented in the Masada Museum and representing each of the construction stages of the site in different eras. An important example of using the digital database for mini-game content is about a mosaic in a room in Western Palace; in this case the mosaic in its entirety was rebuilt and used as a puzzle game (Fig. 8).

CONCLUSION

Ludic activity has played an important role in the history of humanity and accompanies every human being during the period of growth. Starting from birth and childhood, when playing is manifested as a spontaneous activity and allows cognitive development thanks to processes of imitation and emulation, until adulthood, when the playing turns into a leisure activity voluntarily carried out and often becomes manifest in sports activities.

Today video games represent a medium of great importance, able to fill the gap and the widespread disinterest that contemporaryly has opened between cultural heritage and users; the 'Millennial Generation' and all the 'Digital Natives' prefer what is equipped with an interactive screen, ignoring the importance of direct contact with the places, with the works and social relationships in general. It is therefore necessary to exploit this growth in favor of the re-appropriation of museum spaces by users, using videogames as the 'driving force' of innovation and 'cultural promotion'.

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