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Augmented experiences in archeological sites: Presentation of Alexandria Troas Podium Temple to visitor experience

Hakan Anay[a*]
Ülkü Özten[b]
Merve Ünal[c]
Erhan Öztepe[d]

Abstract

Set aside the issues concerning their excavation, documentation, and conservation, as far as their presentation to the public experience is concerned, Archaeological sites represent a special case of cultural heritage that come with distinctive set of conditions and demands, posing a problem situation deserving a special treatment. Problem is manifold: The presentation should be informative, entertaining, and educational, all accomplished through an active corporeal and mental participation where interactivity and immersion must be the key. The setting must provide a holistic, comprehensible experience by completing "missing parts and layers," and contextualizing it, perhaps through a story, a theme, or a background. Any intervention must be non-invasive, reversible and updateable; alternatives and different layers must be presented, preferably, synchronously. Above all, final setting should be subordinate to the primacies of "conservation of cultural heritage," while providing an intellectually and physically accessible and sustainable overall historical environment. This has been an age-old issue for the scholars, a genuine challenge due to the ill-defined nature of the problem situation itself. The present study departs from the proposition that, Augmented Reality (AR), by definition, has a potential to contribute to such a problem situation. AR is a combination of real and virtual worlds, where "virtual" could complement what was missing in the real and new objects and layers might be woven together, into one new reality where active bodily and mental participation and interaction is possible. Though it might seem implied in the definition, the proposition still needs a rigorous investigation since AR is a rapidly emerging but still quite a young field that has a long way to go; and since, research on AR's specific adoption to presentation of archaeological sites, apart from few examples, is still an unbeaten path. The present multidisciplinary study aims to take a step towards such an investigation. Established upon a detailed investigation and analysis of examples, the present study involves development of an AR application of a selected case: "Alexandria Troas Podium Temple," followed by a field study. In the present report, we share our experience and observations of the process and the implementation. In conclusion, we propose that AR is a serious candidate to be a considerable asset for the presentation of archaeological sites for the visitor experience, without compromising the universal norms of conservation of cultural heritage. We also argue that AR seems to have its own agenda, coming with unprecedented possibilities still to be appreciated and adopted, which in turn might help us to go beyond the conventional conceptions and modes of conservation of cultural heritage and presentation.

Keywords: Alexandria Troas, archaeology, architectural (Re)presentation, Augmented Reality (AR), visitor experience in archaeological sites.

*(Corresponding author) [a]Prof. Dr., Eskişehir Osmangazi University, Turkey, info@hakananay.com,[b]Assoc. Prof. Dr., Eskişehir Osmangazi University, Turkey, info@ulkuozten.com, [c]MSc.Arch., Eskişehir Osmangazi University, Turkey, mrve.unal97@gmail.com, [d]Prof.Dr., Ankara University, Turkey, erhanoztepe@gmail.com,
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1. Introduction

Archaeological sites represent a special case of cultural heritage that come with distinctive set of conditions and demands as far as their conservation and presentation is concerned. On the one side of the equation resides the scientific studies, typically involving survey, excavation, documentation, analysis and interpretation, and conservation of these sites. These studies typically do not seek for knowledge towards practical application (as in applied sciences), and typically there might not be a chance to (re)evaluate remains economically, i.e. for refunctioning or adaptive reuse. Main objective and benefit here is towards understanding and explaining and for the production and dissemination of knowledge; and of course above all, ensuring a sustainable life for the cultural heritage. Scientific studies concerning archeological sites have their own methods and processes as well as codes of conduct, rules and principles.

The other side of the equation, the presentation of archeological sites towards visitor experience comes with a different agenda that does not always confront with the norms and privileges of the abovementioned framework. Here, typically, the emphasis seems to be on entertainment and recreation of a visitor, but through these, there is always dissemination of information and knowledge involved, delimiting the educational aspects of such experiences. Learning from built environments and artifacts is a special type of experience since these are not only infused with knowledge operational in their making, to be deciphered, but also investigation of them might give ideas about the contexts and environments (whether cultural, social or physical) within which they were embedded.

Spatial artifacts such as architectural pieces and built environments (including archaeological sites) demand a spatial experience, involving a full corporeal presence and movement in space. Of course, in any genuine experience, corporeal presence must be incorporated by “mental” or “spiritual” presence. What leads such a presence might be a professional interest, a pure curiosity, empathy(or sympathy), a sense of belonging, cultural affiliation, memory, or perhaps a mere urge towards being a part of a community or, saying “I was there.” It must be noted that “mental” or “spiritual” presence is not directly associated with physical and spatial being of an artifact. Through “one’s horizon of expectations,” such a presence gets involved with issues like spirit of a place, life and people, the artifact’s history and story, as well as its meaning and symbolism. A “full immersion” and a holistic meaningful experience further demands consolidation of “spatial” and “mental” presence with active participation and interaction operational at both levels.

Apparently, such a framework poses quite a number of issues for the presentation of archaeological sites. Typically, archaeological sites present a two dimensional (flat), and incomplete environments that hamper a satisfying spatial experience. It is a matter of missing physical context, making orientation and corporeal integration to the environment difficult. Lack of physical context and incompleteness make artifacts (i.e. buildings or built sites) lose their scale, as well as their integration to whole, and the overall sense of unity both within and without themselves. Incompleteness not only concern missing physical parts or layers, or the physical context. It is the social and cultural context that gives a place its meaning, soul and vibe. Archaeological sites on the contrary, are mostly “dead” environments devoid of life and people. They are barren, not only in the physical sense: their story might be forgotten, they might belong to a distant culture and society, the meanings and symbolism they carry once might be either lost or represent a mismatch with the present one. Element of surprise could only carry the visitor to a point (if such a thing exists), and it is not sustainable: such a place should reproduce itself and the experiences it provide.

If we are to treat the abovementioned missing layers to augment the site towards making a meaningful and holistic visitor experience possible, we should apply the questions such as “what, how and to what degree,” to the whole setting, to each layer and to each part. Generally, such built environments are not entities emerged, finalized and frozen at certain point of history, but rather they are a product of time that span a period in history and as such, involve process. It is quite a challenge to present a phenomenon that differentiates and undergoes various changes over time,

and thus having multiple layers those should be treated both diachronically and synchronically. Every (re)presentation is an interpretation if not speculation, and no interpretation in such a setting could be static, unique, final or flawless. There may be equally plausible interpretations, there will always be missing parts and missing information; and of course, as far as data and interpretation is concerned, there is always an issue of reliability. Archeology itself is a process and basically operate on hermeneutics: There will always be new findings and new data, followed new interpretations that could lead to either refinement of existing conjectures, or production of the new; sometimes even elimination of the old ones. Therefore, any intervention or proposal whether it is towards conservation or (re)presentation, must be compatible, honest, non-invasive, reversible and updateable; alternatives and different layers must be presented, preferably, synchronously. Above all, final setting should be subordinate to the primacies of "conservation of cultural heritage" while providing an intellectually and physically accessible and sustainable overall historical environment.

The situation summarized here has been an age-old issue for the scholars, posing a genuine challenge due to the ill-defined nature of the problem situation itself.

The present study departs from the proposition that, Augmented Reality (AR), by definition, has a potential to contribute to such a problem situation.

AR could be interpreted as a synthesized "environment" produced out of digital (ly generated) objects simultaneously transmitted together with the real world. It consists of layers of virtual and the real, weaved together into a new reality, as such presenting an unprecedented potential that could be possible neither in real nor in virtual worlds alone. Interactivity and immersion are the two key features of AR: Beyond being in a state of passive "observer," created environments present the user a world they could be a part of and where, an active, two-way corporeal and mental engagement is possible. Especially, when "augmentation" is considered as that "virtual" layer complementing what was missing in the real, AR seems to be an objective opportunity for the presentation of archaeological sites. However, the situation requires an interpretation going beyond this simple view, and the initial proposition still needs a rigorous investigation. This is so since AR is a rapidly emerging but still quite a young field that has a long way to go; and since, research on AR's specific adoption to presentation of archaeological sites, apart from a number of examples, is still an unbeaten path.

Embedded within the abovementioned framework, the present multidisciplinary study aims to take a step towards such an investigation. As a departure, it presents a concise review of AR, particularly in its application to presentation of archaeological sites. This stage is followed by development and implementation of an AR application of a selected case: "Alexandria Troas Podium Temple." As a conclusion, we share our experience and the observations about the process and of the implementation.[1]

2. Augmented Reality: A brief Introduction and About its Adoption for the (Re)Presentation of Archaeological Sites

Literature typically date practical studies concerning AR back to late 50s and 60s. Its conceptualization and contextualization however, come about in 90s. Thomas Caudell and David Mizell (1992) first coined the term. Pierre Wellner, Wendy Mackay and Rich Gold (1993) put AR on the opposite of Virtual Reality, by stating that unlike VR, AR does not cut human beings off from the real world but establishes an unprecedented set of relations with it. Then in 1994 comes Paul Milgram and Fumio Kishino's (1994) famous Reality–virtuality continuum where anything concerning both the real and the virtual were conceptualized as a "mixed reality." In this continuum, they located AR closer to real environment (Figure 1).

[1] The study is a part of the thesis titled "Augmented Reality Applications in Architecture: Presentation of Podium Temple at Alexandria Troas as a Case for the User Experience" and is supported by the ESOGÜ BAP coordination unit as 202015A114.

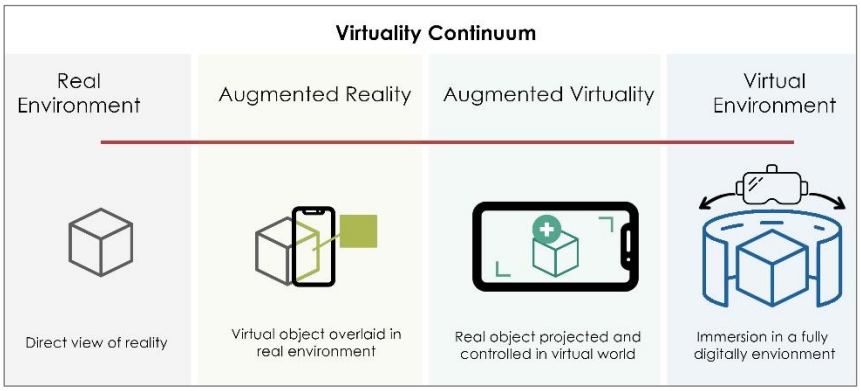

Figure 1 Reality-Virtuality continuum. Authors after Milgram and Kishino (1994).

In 1997, Roland Azuma (1997) defined AR a combination of real and the virtual, while introducing real-time interactivity and three dimensionality as its essential aspects. Studies towards conceptualizing and theorizing AR was parallel to its practical applications, and about the beginning of 2000s, AR started to become a well-defined research field. While, to this date, AR seems to be serving primarily for industry, i.e. aviation, military, etc., especially after 2010s, it started to extend and expand across other fields, such as commerce, advertisement, gaming, and started to be more available for mainstream utilization. Perhaps one of the important shifts concerning AR's lifeline is the development of tablets and smartphones that made AR widely utilized for various purposes and accessible for all.

As expected, AR provided a considerable set of opportunities for the field of architecture, and therefore known to be utilized for various ends: Design conceptualization, representation and collaboration, design education, building (site) management and for the conservation and (re)presentation of cultural heritage (sites) and architectural works. An instance of the last category, AR's use for the (re)presentation of archaeological sites, is of particular interest here.

Before going into a detailed analysis of a number of relevant cases, we could argue that first set of examples (the pioneers) required heavy and complex hardware sets and specialized equipment. Moreover, almost now readily available aspects such as plane detection, object placement, overlapping and projection of virtual and real layers, interaction, and such had to be addressed individually and almost an ad-hoc manner, where each requiring a specialized hardware and expertise. The use was not so practical at all (Figure 2).

Figure 2 Actual use of ARCheoguide (Vlahakis et al. 2002).

Second set of examples are after the introduction of Smartphones and Tablets relied upon these devices' interactive screens, processing and graphic capabilities, cameras, GPS (Global Positioning System), sensors, gyroscopes, magnetometers, and such already built-in aspects, as well as connectivity capabilities such as WI-FI and Bluetooth, almost tailored to fit the needs of an AR application. We could easily say that combined with the already developed expertise coming from smartphone industry (including hardware and software), and already developed familiarity (and dependence) of society upon these devices, led to a paradigm shift in AR's evolution and made it available, accessible, and mainstream.

2.1. Summary of the Case Reviews

Before formulating the study a review of the existing studies concerning AR's adoption for the (re)presentation of archaeological sites were held. Methodologically, above all, the contribution of two major components, namely virtual and the real layers, to the overall augmented experience, and the nature of that contribution were examined. This is followed by further investigation of virtual layer(s), such as buildings, building parts, natural elements, life, themes, scenarios, and information of sorts. We particularly questioned the issues of interactivity, immersion, corporeal and mental presence in relation to all these. Only a number of examples are summarized here for the limitations and convenience.

Perhaps one of the earliest of such applications is AR-cheoguide prepared for Ancient Olympian city of Greece (Vlahakis et al. 2002). In the study, reconstruction of Temple of Hera is embedded into the existing remains of the building. The experience is planned to work interchangeably, i.e. it is possible to turn the augmented layer off to see the existing situation of the site. Virtual reconstruction A building is not the only augmentation the project provides: Audio, 3D models, 2D pictures and informational texts are also given as a part of the virtual layer. In this way, users can get information that could be provided neither by the remains of the site nor the virtually completed buildings.

Perhaps one of the important components of this study is the introduction of intangible cultural heritage as a complementary part: The life of the city. Visitors in the stadium area can experience ancient virtual athletes competing with each other. It illustrates the Olympic Games together with the built environment it takes place in and makes it possible for visitors to have an enhanced unprecedented immersion and experience (Figure 3).

Figure 3 Athletes competing in Olympia (Karigiannis & Stricker, 2002).

Another example Ancient Pompeii (Papagiannakis et al. 2005), as the name suggests, is prepared for the ancient city of Pompeii. As a case, it is different from the AR-cheoguide where its motivation is not towards the virtual reconstruction of the built environment and the buildings, but rather towards the revitalization of the life, possibly due to fact that the remains in this example are already rather intact. Departing from the depictions in existing murals, life of the past was reconstructed as the augmentation layer by using the storytelling technique. Towards this, virtual-human characters have been created and these characters acted according to a certain story and a scenario. For example, visitors observed an ancient woman preparing food in the thermopolium as once before (Figure 4). This particular application promotes the use of AR for the revitalization of one of the layers of intangible cultural heritage as a part of the built environment and puts a particular emphasis on the spatial characteristics of ancient architecture (rather than the external form) and their use. Frescoes are also utilized for the reconstruction of flora and fauna, later presented as an augmented layer.

Figure 4 Thermopolium, AR character preparing food (Papagiannakis et al. 2005)

AR project of Aurelian Wall at Castra Praetoria in Rome (Canciani & Saccone, 2016), provided the full process including the studies prior to the development of AR application, such as historical research, documentation (surveying), and restitution. It provides mobile AR experience (Figure 5).

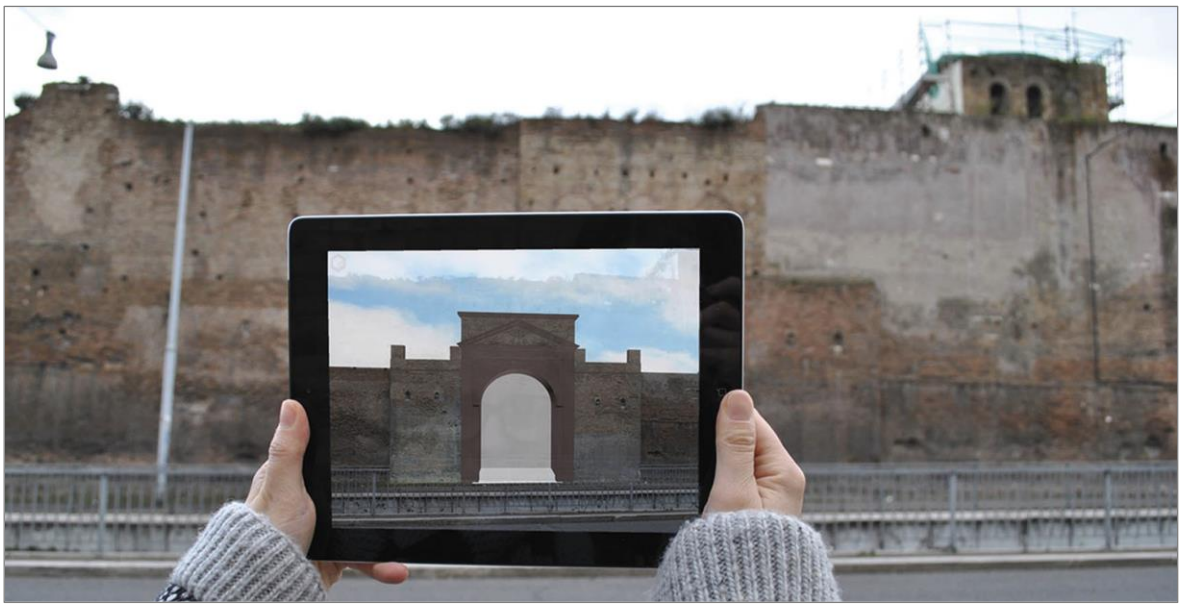

Figure 5 Early Examples of Mobile AR (Canciani & Saccone, 2016)

Another study is about a Roman Villa located in Valladolid (Finat et al. 2015). One of the final products of the study is a virtual model of the villa but the process itself particularly has unique characteristics. The problem was the complex stratigraphic layers and partial excavations, demanding a special treatment and interpretation. One of the intentions was to present visitors an interactive navigation while showing various layers and giving a certain interpretation of the site (Figure 1). Further interactivity was added by asking some simple questions and assigning minor tasks and puzzles. This example also presents documentation and restitution process prior to the AR application.

Figure 6 Layers of Different Periods (Finat et al. 2015).

AR project of Parthenon Temple (Liestøl, 2011) carries AR to another level. Here, documentation and restitution is not the issue. Although it seems to be intact, many details of the temple, i.e. friezes carried to the nearby museum, were missing. Another problem was the limited accessibility, due to the confrontations of conservation that made access within cella impossible. As such, a contextual holistic experience would not be possible. The project provided the missing details, even the statue of Athena, as an augmented layer. What is particularly important here was the use of interactivity. Visitor could made the outer shell transparent, to various degrees, and as such without losing the sense of unity, observe what was inside the cella (Figure 7). Also "zooming" certain parts of the buildings made possible, to observe the details. A further interactive layer is also provided to give information about the building and the details, and for contributing them. Particularly in this study, we see an emphasis on "mobile" devices as primary devices for AR.

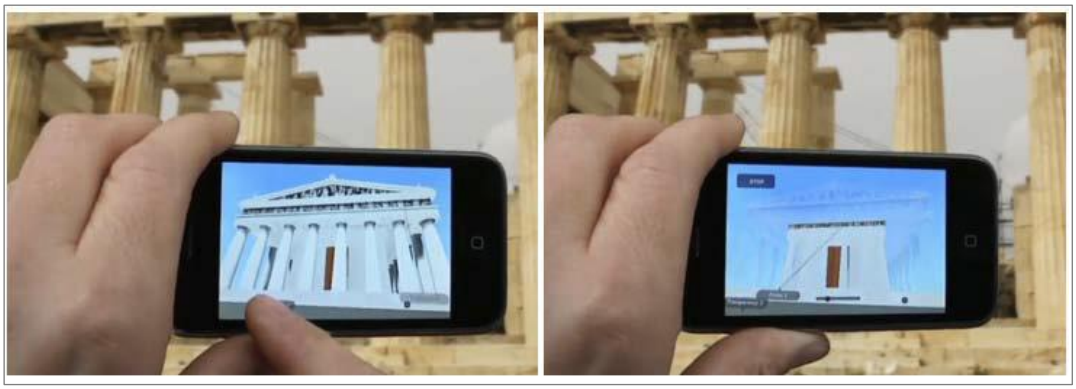

Figure 7 Parthenon Temple, Zooming-in and Transparency in AR (Liestøl, 2011).

Another example is Temple of Deified Julius Caesar (Liestøl, 2011). Here the virtual reconstruction of a building is not the primary issue. As the visitor approaches the temple, the application asks, "if they want to experience the events that led up to the building of the altar and

the temple." Then it rolls back time to the death of Julius Caesar, 44 B.C., and start to tell the story through a set of animated scenes and situations (Figure 8). Here augmentation involves the "time" dimension, manipulated in two ways, and also there is a cinematographic narrative as an augmentation. Nature of immersion and experience here is particularly unprecedented; it makes the visitor a part of history.

Figure 8 Roll-back in time. Crowd, Mark Antony's Speech (Liestøl, 2011).

3. The Case Study: Designing an AR Experience for the Podium Temple of Alexandria Troas

Selected case, Alexandria Troas, is a city, initially established in 311 BC, by Antigonos Monopthalmos. First, it was called Antigoneia, later Lysimakhos renamed it as "Alexandria Troas," after the Ipsos war. It was governed under Seleukos between 281-226 BC, and it was known to remain as an independent state until 65 BC (Ricl, 1997), (Öztepe, 2012), reports that, during the reign of Emperor Augustus, the city reached its heyday, as a colony of Rome; "Colonia Augusta Troadensis." It was an important port city throughout its Roman period, and the city is known to be an important exporter of monumental monolithic columns, "marmor troadense," to all around Mediterranean (Feuser, 2009), (Feuser, 2011), (Öztepe, 2019). In 1st century AD, during his second travels, St. Paul visits the city, and sails towards Europe to disseminate the essentials of Christianity to Europe, first time in history (Acts16:6-8), (Körpe, 2015).He revisits the city during his third missionary travels and stayed awhile, after which the city became an episcopal center (Acts 20:6-12), (Glavic, 2014), (Wilson, 2020)The city is known to lose its economic power after the Goth invasion, together with its port losing much of its functionality by time. In 4th century AD, it was one of the capital candidates of Roman Empire, but lost to Constantinople, and the city lost its importance and started to decay. Recent studies show that settlement in the city remains until the Middle Age, but it was quite insignificant. In Ottoman times, it was called "Eski İstanbulluk" by Piri Reis. Perhaps one of the important and ill-fated periods in city's history is 17th century when many of the buildings were dismantled down to their foundations and taken to Istanbul to be used in the construction of new buildings (Cook, 1973).

Today a few remains of buildings such as Doric and Podium temples, Odeon, baths, stadion, nymphaeum, main street (Decumanus), theater, waterway, port and some of the city walls are more or less above the ground and observable, but mostly all in very bad condition. At its present stage, the focus of the visitors is mostly the forum area (Aside the Herodes Atticus Baths to East) defined and surrounded by a number of architectural and urbanistic elements, where at the core, the Podium Temple is situated. However, most of the remains are either not unearthed or unearthed ones were stripped to the bare foundations, thus neither giving a holistic idea of themselves, nor about the forum itself as whole.

3.1. Investigation of Problems and Conditions Concerning the Presentation of the Forum: a summary

Before going into designing an AR experience, we analyzed the patterns of behavior and use by the visitors. Access to site was always through the car park area to the East, since the existing road did not permit pedestrian access otherwise. Generally, people pass through with only gazing the remains. If they decide to stop, they enter the archaeological site from the Northeast corner where

they first get a glimpse of the major building remains: to the left is Odeon, remains of a dodecagon building, to the right resides partially excavated Decumanus and a row of shops, and axially located are the remains of the Temple and the fountain. Generally, it was observed that people right away proceed by the Temple and at the Northeast corner of it, stop and read the information panel about the building. After a while, after taking a few photos, they go on and walk along the North edge, and reach the end of the forum while also checking out the findings under the porch to the North. In many cases, the visit ends there, and people go back to parking area and leave since there seems no more worth to visit. Often, it becomes a fast-paced endeavor that could not be interpreted as a satisfactory experience. Dodecagon building and sculpture hall to the North is almost always passed by since their primary spatial aspects of them are not shown. A number of situations are observed to be changing or slowing down this course: First, as it was stated, due to the written and graphical information about the findings, i.e. the info panel at the Northeast corner of the temple. Second, if there was an expert at the site (professors, archeologists, guides), the experience turns into a dialog, missing parts and pieces together with the informational and historical layers, sometimes stories completed by the expert make the visit longer and more satisfactory. The dialog often develops in two-ways, by questions and answers. Third, pre-informed visitors might go on to seek the attraction points. The source of pre-information was generally mass or digital-social media, and people seek for popular places or go towards re-experiencing other people's "shared" previous experiences. Forth, if people see other people going around and checking out other things, or archaeologists working, in case of any crowd and movement, they just tend to follow. It is observed that this also helps to catch people passing through by car. If the site is crowded, people tend to stop.

Therefore, first targets towards its presentation should be to make the site more attractive at first sight and make it more accessible. Then second would be to go on and support the initial attraction by providing continuity between points of interest. Such a fluid flow needs slowing down or delay at some points where main events take place. Towards a satisfactory experience, missing parts and layers should be augmented by various means: not only physically, but also by providing people and life, through a theme, a scenario or a story. Finally, as we have emphasized earlier, visits must be more interactive.

3.2. A scenario for Alexandria Troas Forum: Towards a montage of attractions

After analyzing the patterns of behavior and use by the visitors, we investigated the site, and points of attraction, starting from the entrance while numbering them as reference "scenes." The aim was to identify the nature of the existing material at hand, and draw a sketch of a visitor experience accordingly. Here our main intellectual reference was Sergei Eisenstein's, early theories on film, i.e. "montage of attractions" (Eisenstein & Gerould, 1974) and his readings and interpretation of experience of Acropolis in his "Montage and Architecture" (Eisenstein, 1989) where he interprets acropolis from a cinematic point of view. We also refer to an emerging design field "experience design" as our conceptual and theoretical source.[2]

The sequence of Scenes are diachronic, later to be montaged to provide a holistic AR experience (Figure 9).

[2] For example see (Dewey, 1980)(Hassenzahl et al. 2013) (Shedroff, 2001) (Benz, 2015) (Anay, Özten, & Özten Anay, 2014) (Özten, 2019).

Figure 9 Visitor Experience Sequence of Scenes.

Scene 1-2: Approaching from parking area (P) North of the entrance (E) is dodecagon building and so-called sculpture hall (Scene 2). They are fully unearthed, but upper structures are incomplete, and they do not give idea about their overall form. These buildings are important for their spatial characteristics, and the things to be presented inside them, rather than their outer form. Dodecagon building has its mosaics, inner ornamentations, and sculpture hall has its sculptures presented on a podium, therefore both should be experienced from inside. At their present stage, none of these assets is on-site, and replacing them through AR is an opportunity.

Scene 3: To the West of entrance, it is the Decumanus (Figure 10). A number of cells (shops) lay along its South border. It is partially excavated, but giving a sketchy idea about its scale, orientation, construction technique, etc. Visitors sometimes wonder the street towards West. To the West end of the street is the remains of a Roman Arch that is neither visible nor accessible from this point. Street as a linear element could be best experienced by movement, by being inside, by walking through it, or watching people doing things and walking around. Virtually augmenting Roman arch and completing the shops would contextualize it and bring it its lost spatial characteristics. What is missing here is not things, but the life and people. We decided to tell a story about an important event in time in the city's history here as an augmented layer. It is about reanimation of one of the visits of St.Paul (Acts 16:6-8) (Texier, 2002) in history, walking from the ancient harbor, along the decumanus. During experience one of the apostles come towards the visitor and tell the story about the event.

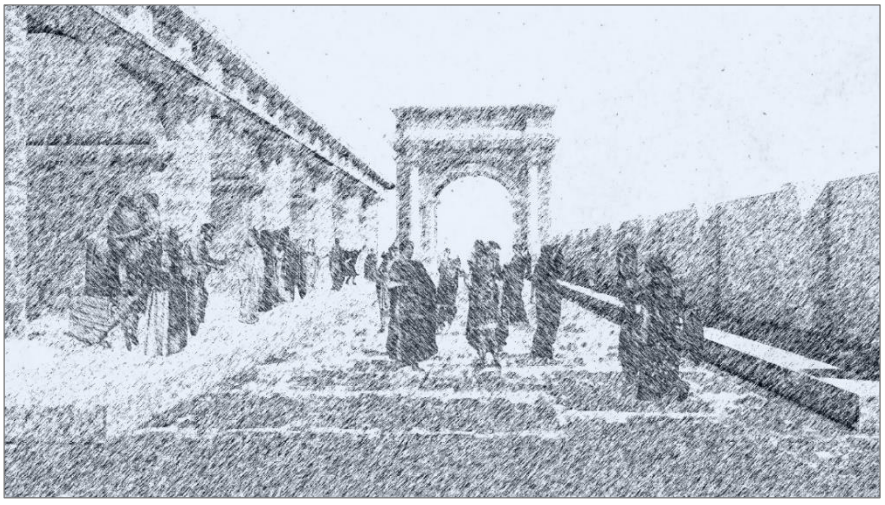

Figure 10 Scene 3: Thematic Reanimation of Decumanus.

Scene 4: Passing through these scenes, visitors are now inside the forum, where to the Southeast corner of it, adjacent to the dodecagon building and the sculpture hall, resides the Odeon. It is only partially excavated and giving us a trace information. No rows of Odeon and no scaenae exist at its present stage. Here aside the building parts and the overall external form, missing layers are the people and the acts, where crowd, movement, sound, etc. should be involved. We also decided to tell a visual story about an important event in time in the city's history here. The story is inscribed on a stone and it is about a musician from Lesbos who was commended for his exceptional performance in a competition that take place in the Odeon (Schwerteim, 2002). We decided to reanimate the performance and through AR, make visitors to sit on the slopes of the Odeon and watch the performance, where the forum, temple and Tenedos is at the background.

Scene 5: At the center of the forum is the podium temple, together with a fountain to its East, and an altar to its West (Figure 11). These three should be considered as a whole. All three are fully excavated but what is left is only the foundations and giving no idea about their overall form. All these are important in the sense of their missing sculpturesque characteristics (external form) and must be primarily augmented in this sense. The fountain and the altar are also complementary elements to the overall composition of Temple. Podium Temple is the heart and soul of the forum, the main attraction in the site. Apart from completing the missing architecture of it, the life around it is particularly important, especially together with the altar. We decided to present a ritualistic ceremony, where temple and the forum at the background, and there is crowd involved.

Figure 11 Scene 5: Thematic Reanimation of Podium Temple and the Altar.

3.3. The Case: Scene 5, Podium Temple

In such a context, we selected the temple as the first scene to work on. First, since it is already the visitors' main point of attraction, it is convenient to present it through AR and then test it. Second, it might be a departure point, a trial to learn from for a more comprehensive and inclusive study. Third, there is almost nothing left from it except the foundations to give a three-dimensional holistic idea about it, and there is nothing to do about this in conventional means.

So-called podium temple is dated as early imperial and the remains led researchers to decide it was built in Corinthian order (Görkay, 2002). Apart from the conjecture that it was a podium temple (referring to the traces of foundations), it would be hard and quite speculative to tell anything else about its main layout, elements, form, and style. Although there is as attempt towards its restitution, as such, it is almost impossible to do something towards its representation to visitors, at its present stage by the conventional means. AR on the other hand might be a feasible option, since it permits speculation, and it is essentially non-invasive.

Following the traces of the foundations, using Gorkay's (2002). existing study as a departure point, and after a number of interviews, we decided to develop our AR model upon three distinct restitutions of the temple based on three likely probable layouts: prostylos, peripteros, and pseudo-

peripteros (Figure 12). After this decision, we conducted studies towards restitution of the variations. Proposals then were modeled in ArchiCAD.[3]

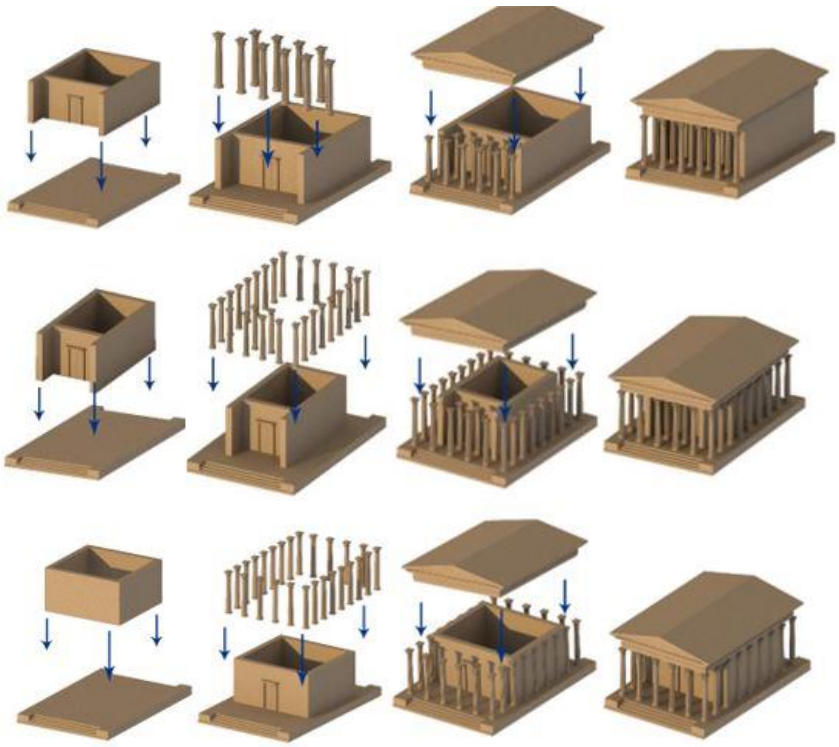

Figure 12 3 Temple Alternatives.

3.4. Developing and Testing an AR Application

During the study, we tested two distinct approaches: GPS placement and manual placement. It is about the question how virtual, and the real layers are woven together successfully. Typically, AR applications use hardware's in-build capabilities such as Cameras, GPS, Gyroscope and Accelerometer. In addition, the means of locating the virtual layer might be by using GPS, recognizing a Marker, or manually. We tried both the GPS and the manual placement methods. GPS would be a logical and practical solution since placement is automatically made by the application. However, GPS provided unprecise results since the signal is always distorted and precision is roughly 2 meters max. Manual placement was also feasible, but placement needed a manual labor just before the experience begins. It was not the aim of the study to evaluate and/or compare the capabilities of hardware. But we observed that it is a part of the equation, a very important one. We used a state-of the art version of an IOS (IPAD operating system) based tabled. Even if so, the machine did not support the virtual model fully. Frame-per second, an important indicator was well below the acceptable standards, if texture and light were to be included. There were aspects without which an immersive precise experience would not be so possible. Optimization might be key but still, we thought that hardware capabilities are yet to advance to support rigorous AR applications. As far as development of the application is concerned, there were two major paths to follow. One is Android (Google's Mobile Operating System based on Linux) the other IOS as the development platforms. As far as the capabilities of both are concerned, ARkit[4] and ARCore[5] provide

[3] To our experience, Archicad is not the optimal choice in this sense. Rendering capabilities of smartphones and tablets are way behind the capabilities of a graphic-card supported system, i.e. desktops and laptops. Therefore, one should seek low-polygon models and textures accordingly. There are a number of choices in this sense such as MAYA, 3DS, Blender for general purpose modelling, and architecturally Sketchup provides a relatively viable option.

[4] ARKit is Apple's framework and software development kit that developers use to create augmented reality games and tools. (https://appleinsider.com/inside/arkit)

[5] ARCore is Google's platform for building augmented reality experiences. (https://developers.google.com/ar/develop)

almost identical opportunities for the developer and the user. A cross–platform development perhaps would be a better choice. For example through Unity[6], and ARfoundation[7] or Vuforia[8] it is only a matter of compilation.

In its present stage AR goggles are barely available/accessible for the ordinary end-user. This option would perhaps might lead to solutions that are more rigorous since they are designed solely for this purpose. The second option is wearables, handheld tablets and cellular smart phones that present a great opportunity. These are already embedded within people's daily life and people are used to them as visual devices. They also have connectivity. We traced this objective opportunity.

We developed our application for IOS, and consequently used ARKit library under Unity as our development environment. Object placement, when the virtual layer is calibrated and overlapped with the real have had a particular importance here. Typically, the device first have to analyze the environment through its camera and sensors and establish a virtual model of the real within itself. Then virtual layer has to be "placed" onto the real by various means such as GPS, manual placement, and placement by image recognition. We used first two and decided to go on with manual placement (Figure 13). Since there were three alternative versions of the temple, we utilized click gestures to browse through them (Figure 14). After all the visitor is free to do whatever she likes, go around, get close to the temple, or get back to have a better overall view. During this process, the initial model had to be optimized and some aspects such as lighting, and textures had to be removed for the sake of achieving a plausible performance.

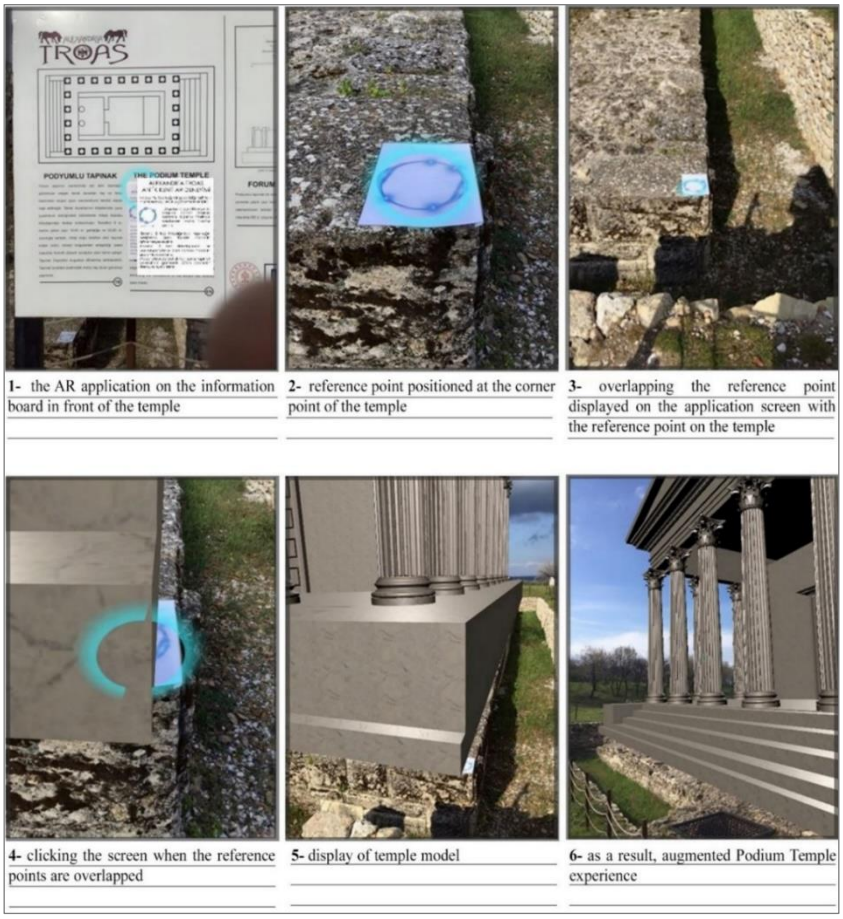

Figure 13 Manual Placement of Virtual Model.

[6]Unity is a real time cross-platform development environment. (https://unity.com/)
[7]AR Foundation is a cross-platform framework that allows you to build augmented reality experiences once, then build for either Android or iOS devices. (https://developers.google.com/ar/develop/unity-arf/features)
[8]Vuforia is a comprehensive, scalable enterprise AR platform. (https://www.ptc.com/en/products/vuforia)

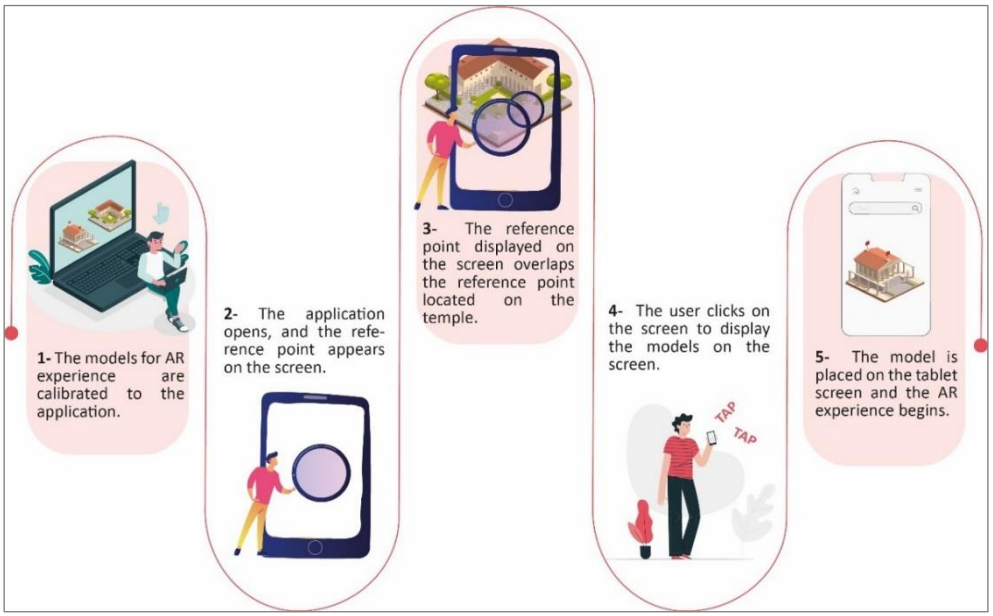

Figure 14 Calibration and Click-gestures of AR.

3.5. Field Studies: Basic Observations

After the development of the application field studies were carried out to calibrate, apply and evaluate the application. At this stage, a text describing the AR experience has been placed on the information board that visitors encounter while experiencing the area (Figure 13). On the board, visitors are told how they can experience the temple with the tablets on which the application is already installed. We also informed them this was a scientific study and asked if they would like to participate. We recorded and documented the experiences then go on to decipher and evaluate them. There were more than 200 participants during our studies (Figure 15). This was a separate study that has its own targets and specificities, and it is still being evaluated with its own methodology. However, sharing some of the first observations are particularly important for the present purposes.

In general, element of surprise was always there, and many of the visitors met the experience with exclamation. This is partially due to unfamiliarity with the AR. However, visitors also stated that they did not imagine the temple as such. After the experience, they expressed their firm belief on AR's support towards understanding of historical and cultural value of the structure. Some of the repeated comments are, "It triggered my imagination" and "It takes people to the past." These two shifts (or displacements) in perception and awareness we particularly find significant. One of the gestures after they see the model first time was a sudden urge towards paying attention to other parts of the site. The also expressed this verbally: "I wish I could see the entire historical environment," "What about the surrounding?" "What about the building there?" They also asked much about the use and the acts going on and around the temple. Visitors stated that they want to have such an educational and entertaining experience in the whole area and even in different ancient cities. Experience also triggered movement, we observed people tend to go around and examine the surrounding. It has been observed that especially the children and teenagers are particularly interested in the experience. Almost everyone demanded a photo or a selfie in front of the Temple and the visitors spent considerable time even during this single-building experience. Responses from experts (architects, archaeologists) also tend towards seeing "more" but in a different way. Professionals emphasized that the model could be developed further (especially in the detail level). However, they affirm that it would be highly educational to experience the field in

this way. We also observed that people have had no difficulty to adopt themselves to this new type of experience.

Figure 15 Visitor Experience.

4. Conclusion

Before going through conclusions and remarks one must not forget the fact that abovementioned observations are towards the use of AR for the (re)presentation of archaeological sites, not their conservation. All in all, AR is a serious candidate to be a considerable asset for the presentation of archaeological sites, without compromising the universal norms of conservation of cultural heritage, but maximum non-invasive characteristic of AR only takes us so far. A plausible (re)presentation model, whether it utilizes AR or not, should go hand in hand with a rigorous conservation approach and a master plan to ensure the preservation of cultural heritage. AR's potential contribution towards this ultimate aim, however, is yet to be addressed.

In addition, one must consider the fact that the present research was a pilot study with a number of limitations. While providing a number of answers to the initial conjectures, due to its limitations, first, it did not permit us to develop a full, comprehensive model and test all the conjectures at mind and second, it raised a number of new questions to be addressed. Perhaps next step would better be the expansion of the scope of the study, i.e. implementing a full AR application of the forum area as planned. We also believe that the application further needs to be raised to a higher level involving more depth (including life, history, stories or even a scenario as AR layers) and in detail (a more comprehensive AR models of assets, detailed revitalization of parts), while incorporating all these with interactivity and connectivity.

As it comes to conclusions, first thing to note is the that utilization of AR for the presentation of Archaeological sites demands a multidisciplinary study that involves quite distinct tasks to be addressed and, thus requires expertise in various fields, all to be organized in coordination. In turn, it is very hard to summarize and report such a multi-faceted, complex study, not only it contains much, and sometimes incompatible issues to address, but since it could be taken in various means, with various emphases. Here, in this report, we tried to make a review of the whole process, by giving an outline, and pointing out the essentials, without going into detail in any part of the study and without any particular emphasis. The ultimate aim was to examine and evaluate the potentials of AR for the presentation of Archaeological sites.

Perhaps the first thing to mention that AR brings to fore is the element of surprise and its potentials towards arousing curiosity and interest among visitors. Consequently, visitor from

passive observer stage became an active participant. People started to ask questions, wonder, seek, and try to see more, even touch. This is also related with missing layers replaced by AR, increased people's level of perception and awareness.

As we observed the behavior of the visitors, we identified a recognizable vibe and joy in their AR experience. Their attention was fully on the Temple through the screen; they showed things, made comments to each other, generally with enthusiasm, through wide spectrum of verbal, visual and auditory stimuli, people became active part of the experience. We particularly observed the full attention of children and young people, try to ask and learn. Apparently, apart from its recreational power there was also an implied pedagogical potential of AR. Visitors also tried to develop a familiarity with what they have been observing, through seizing and internalizing it by various means. They scaled it by their bodies, by movement, they tried to incorporate it within their previous experience and knowledge, even try to project back on what they have seen. This we believe implicates an urge towards developing a sense of belonging and immersion. Visitors also seemed to appreciate the AR technology itself, developed a quick familiarity with it although this was their first experience.

We strongly believe that AR is quite different from VR, as an approach to present archaeological sites, as it seems to work as a natural extension of corporeal and mental being and existence.

Apart from our observations deriving from in-situ application of AR concerning visitor experience, there are also observations concerning the use of AR in conservation and presentation of cultural heritage. As far as AR is concerned, presentation becomes as non-invasive as, and as rich as it gets; physically, almost next to the real thing, otherwise, almost to an unimaginable level. Of course, there seems no apparent active involvement of conservation, i.e. one cannot stop decay due to climatic conditions, natural disasters, through AR. But maximum non-intervention side by side AR's rich potential through which to say/present almost anything about the remains brings an unprecedented setting to play with, permitting variety and creativity; permitting temporarily with permanence, speculation with reality, all mixed together to be weaved into a new, sustainable environment. Beyond the obvious, i.e., use of AR for the augmentation of the missing physical parts, and providing general information, it comes with a number of novel capabilities those are worth to be explored further. First is about time and history, and it is related with the diachronic view of the historical phenomena: in an archeological site, you are at the end of its history, and only be able to gaze at the present, or a certain revitalized period frozen back in time, no matter how the site was presented in conventional means. AR however, permits breaking down this space-time continuum, and help us to roll-back and fast forward in time, warp between periods, and make a dynamic representation of time, and stratigraphy of periods possible. Second is about the synchronic view of its history and this also involves stratigraphy of periods and augmentation of incomplete layers. We already mentioned the obvious track to follow, i.e., completion of physical aspects. Here, AR makes synchronic projection of alternatives, varieties or sometimes speculations possible, presented side-by-side or one over another. And it is possible to reverse back a proposal or replace it with a more plausible one at any time. Such an environment, supported by AR is infinitely open to extension, expansion, and update, both in synchronic and diachronic levels.

In addition to all, AR enables intangible layers such as people, life, a story, or an event to be presented together with the physical. We particularly evaluate this as a valuable asset privileged by AR that would promote an unprecedented, rich experience involving both corporeal and mental presence, and immersion.

As such, AR seems to have its own agenda, coming with unprecedented possibilities still to be appreciated and adopted, which in turn might help us to go beyond the conventional conceptions and modes of conservation of cultural heritage and presentation.

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Resume

(Hakan Anay has bachelors, masters and Ph.D. degrees in architecture from the Middle East Technical University. Fields of interests are architectural design, design research, design criticism and theory. He is one of the editors of the Architecture Theory Library project in ESOGU with Ulku Ozten) and currently working on Augmented Reality in Architecture, with a particular emphasis on presentation of built-heritage and design of augmented experiences.

(Ulku Ozten holds masters and Ph.D. degrees in Architecture from the Middle East Technical University. She teaches architectural theory and conducts design studio in Osmangazi University Department of Architecture. Fields of interests are epistemology, theory and criticism of architectural design, architectural research. She is one of the editors of the Architecture Theory Library project in ESOGU with Hakan Anay) and currently working on experience of space in terms of AR.

Merve Unal graduated from Necmettin Erbakan University, Department of Architecture in 2018. She completed her master's degree in Building Science at Eskişehir Osmangazi University in 2021 and started her doctorate education. She is still continuing her doctorate education. She is currently working in the fields of Virtual Reality, Augmented Reality and Artificial Intelligence within the scope of 100/2000 PhD Project.

Erhan Oztepe, who graduated from Ankara University, Faculty of Language, History and Geography, Department of Classical Archeology in 1988, completed his master's degree in 1991 and his doctorate in 1999 in the same department. He continues to work as a professor at Ankara University, where he started to work as a research assistant in 1992. He has been chairing the Alexandria Troas Excavations since 2011. Since 2009, he has been a member of the Trabzon and Çanakkale Cultural Heritage Preservation Regional Board of the Ministry of Culture and Tourism. His fields of interests are Greek sculpture, Greek and Roman iconography, Cyprus archeology, archaic and classical Cyprus sculpture.