Enhancing User Experience through Interaction Design

Rethinking the municipal agora of Chania through AR narratives

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*This paper examines the relationship between designing interactive experiences
based on new technologies and the process of architectural narration. It
highlights the idea of rethinking a building with historical, architectural and
functional value, as an experience and a journey. Referring to the historic
building of the Municipal Market of Chania, Greece and using the conceptual
idea of designing through narratives, it delineates the process of integrating new
technologies into the process of designing a spatial and temporal experience.
Exploiting Augmented Reality, we design an application implementing a digital
layer with architectural and historical content, that is integrated into reality,
improving the on-site visit, providing enhanced understanding of the building and
introducing experiential visitor-building interaction. The application is available
through mobile devices and the proposed system is evaluated by a group of users
showing the positive effects of the use of interactive technologies in redesigning
the experience of a space.*

Keywords: *Mobile AR, cultural dissemination, architectural narration,
interactive spatial experiences, interactive visualization*

INTRODUCTION: AGORA AND ISSUES RAISED

User experience in the built environment is increasingly discussed, observed and visualized in recent scholarly articles, studies and experiments. In most cases, the goal is to acquire a holistic picture of how users interact with the built space. However, there are few examples that aim to enhance user perspective and offer an augmented experience through the use of new technologies. This work presents the study of designing and developing a new digital layer (effect on physical space) by designing through narratives (Lehman, 2018; Achten, 2014), implemented with Augmented Reality technology, aimed at enhancing user experience in the Municipal Agora of Chania, commonly known as the "Agora". The Agora, is a historic building, located at the in-between zone between the old and new city of Chania. Being a sig-

nificant point of interest for tourists and visitors, it is used as a central market on a daily basis, thus creating a commercial hub, fully integrated into the everyday life of the citizens. Previous research has shown that visitors of the Agora experience lack of orientation and absence of comprehension regarding the historical and architectural value of the building (Karagianni, 2019). Based on the experience mapping of the existing building setup, the weakest points of the overall experience are being identified and a new perceptual route is designed by connecting interactive setups at nodal points of the site. The aim is to experientially highlight the dual role of the Agora and its urban and monumental value.

RELATED RESEARCH - TECHNOLOGY

In the field of Architectural Heritage, buildings are usually treated entirely as monuments, thus the historical and / or architectural value of the space remains easily distinguishable. However, in historic sites like the Municipal Agora of Chania that are still used by the public on a daily basis, the duality of their character may become blurred and it is difficult to recognize particular historical and architectural features. Often, such buildings are dominated by their functional character and the promotion of their cultural and structural value must be revived using targeted techniques. In order to understand the need to preserve and highlight elements of the history and architecture of buildings with dual character, it is important to identify the spatial, historical and morphological qualities and rethink the site. This activity supports that the visitor's experience is redesigned based on them, enabling her/him to understand the current state of the building as well as its initial form. Lehman introduces the idea of rethinking a space by creating a narrative with the help of technology (Lehman, 2018). The work proposes a new typology for a public library in which the amelioration of the experience comes through a new narrative. In this case, using technology to develop a designed digital layer into the concept of a library as it is known until today, creates a fertile ground in which

the experience of the users can grow and evolve. Cultural Heritage (CH) dissemination has been enhanced for decades with Information and Communication Technology (ICT) tools. Experts manage to preserve and/or recreate and make information about historical artifacts, buildings and sites accessible, exploiting techniques and tools for recording, documenting and visualizing content (Ruffino et al., 2019). In the field of Architectural Heritage (AH), ICT tools are used to complete and highlight spatial and morphological elements, reconstructing the form and nature of damaged or illegible architectural features, presenting the current state and approaching the artifacts' original state (Parthenios et al., 2014). CH professionals are the presenters, and people are the observers in the effort to preserve and disseminate the value of a historic structure. In recent years, we have experienced the emergence of Extended Reality (XR), which refers to Virtual Reality (VR), Augmented Reality(AR), and Mixed Reality(MR), along with real time interactive technologies (Fast-Berglund et al., 2018). Exploiting these technologies, experts have at their disposal tools that can turn their audience from an observer, into an actor and spatial user. Kiourt et al. (2020) contend that XR technologies have the ability to reveal hidden, unknown or illegible elements and stories, thus, attracting the visitor's attention, offering him/her the satisfaction of a deeper understanding of the site. Augmented Reality (AR) refers to the actual Reality enhanced by computer-generated content (Azuma et al., 2001) and is ideal for sites with architectural-historical value that need to be highlighted or interpreted experientially on-site, enabling the visitor to visualize virtual information (spatial, historical, morphological, structural) within the real space, resulting in an in-depth understanding of it. In addition, given the low cost and increasing use of mobile devices, the application of Augmented Reality through mobile applications-Mobile AR (MAR) (Angelopoulou et al., 2011) is an easily accessible state-of-the-art solution to enhance the on-site experience of visitors to an area of interest. Today, several studies focus on the use of MAR to en-

hance the visitor's experience in places of interest, thus taking advantage of its potential. Panou et al. (2018) introduce a MAR application to demonstrate sites with historic value located in the old town of Chania, Crete, Greece. Angelopoulou et al. (2017) proposed a multi-user MAR educational tool for the archaeological site of Sutton Hoo (UK). KnossosAR (Galatis et al., 2016) is a MAR educational tool for supporting the experience of the archaeological site of Knossos (in Crete, Greece). Furthermore, AR can become the means to better understand and evaluate an architectural idea for the purpose of intervening or redesigning/reusing an existing space, improving current practices of visualizing the design and conceptual process, and creating a realistic spatial relationship between the virtual version of the architectural idea and the physical space.The present study focuses on exploiting MAR technology to design a digital spatial, chronological and architectural narrative to enable the visitor to understand the duality of the character of the building of the Agora through an on-site experience. The purpose of this study is to propose a solution through AR technology for highlighting qualities that are difficult to extract from the history and architecture of the building, thus assembling a complete narrative image of the present, past and future of its existence in time and space.

METHODOLOGY

This experiment is part of an ongoing research on the experience of the Agora. The first part (Karagianni et al., 2019) examines the relationships between interactive design strategies and the process of architectural design, through an IPS location tracking experiment and a survey on the users' experiences of the building. As such, a number of issues emerged from this research. The general experience was rated as positive but the users pointed out some shortcomings of their visits. Some users found the place quite uncomfortable due to the crowds, the odors in the markets and the bad ventilation of the building. Because of these factors, they intentionally avoided visiting the rest of the building. Furthermore, due to the

scale, the symmetry of the building and the absence of information, they commented on the inability to orientate themselves. The users failed to recognize not only the layout but also the duality of the place because some of them were attracted to the markets selling tourist products and thus restricted their visits to only certain parts of the building. As such, they did not notice the monumental aspect of the Agora, and they concentrated only on the center with its information kiosk. However, the majority of users who had the opportunity to browse the place virtually before visiting gained a better understanding of the dual role of the Agora, and its architectural form. Many users commented that large parts of the Agora need to be improved in order to be more attractive and to ensure an understanding of its dual role. As a result of all these observations, the aim arose to tackle most of the flaws in order to offer a great number of interesting stimuli for the users through which they could enhance their experience and their knowledge. The technology at our disposal gave us the opportunity to design a narrative through a digital layer and offer users a more constructive experience. The research implemented mobile-AR so that the application would be easily accessible to the visitor with a mobile device (phone or tablet, Android or iOS), with a focus on exploiting marker-based AR and markerless AR (Bekele et al, 2018) (Kiourt et al., 2020). Specifically, the marker-based technique is a method of recognition of a 2D image (image target), such as an image, a QR code, colored or monochrome, placed in the physical world acting as a marker that can be recognized by a camera. When the camera detects the marker, the predefined virtual content is displayed on the top of the marker. Marker-based AR has the advantage that it can support user interaction with virtual content by detecting hand gestures over a specific area of the marker which acts as a virtual trigger (Marker-based Virtual Triggering)(Theodoropoulou et al., 2020). When the camera detects the interruption of the camera's visual contact with the virtual trigger (like a hand movement over the virtual trigger), then it can trigger a prede-

fined function related to the virtual content. Markerless AR is based on the recognition of features and shapes of the physical object without the need for a static image target. The present study chose to utilize both types of Augmented Reality, depending on the point of interest of the building, the type of virtual content and the type of spatial experience involved. After the application was developed, it was evaluated by a group of 15 users who were randomly selected during their visit to the site, in order to obtain feedback from their experiences and to compare this feedback with that of the previous survey. Because of the fact that the Agora is a busy place and that in the previous evaluation the crowds and the temperature were viewed negatively, month and time was chosen (February, morning) with mild weather conditions and a moderate number of visitors.

DESIGNING THE ROUTE

To enhance the users' experience within the Agora, a narrative route is designed to reinforce the perception of the dual role of the Agora and attempt to alleviate some of the problems noticed in the previous survey (Karagianni et al., 2019). The design of the narrative was based on the basic form of the building, utilizing the its cross shape . The narrative concerns the whole building from the bottom to the top. The implementation of Augmented Reality uses the entire height of the building, applied firstly on the floor at the entrance of the building (markerless AR), as well as to the highest point of it (markerless AR), its roof. In addition, the basic historical, morphological and functional elements that emerge as part of the narrative scenario of the space were identified. The beginning of this narrative is set at the main entrance of the site, where the Agora is being presented as an architectural whole. Specifically, information about the spatial, historical, architectural importance of the site is being presented, through an AR interactive experience giving the users a first impression of the building. The second point was chosen because of the low rating it received from the users in the previous survey, in terms of experience, understanding

and visitability. Thus, aiming to enhance the experience of visitors throughout the entire building, reinforcing this area is very significant. This point of interest is the exit that connects the Agora with the old town of Chania and this connection plays a very important role in all the concepts of the establishment of the building. It must be stressed that the whole project of the Agora sought to beautify the city of Chania, becoming an emblem of liberation from the Ottoman yoke. The third point of interest, even nowadays remains the most visited and gives the most complete piece of information about the Agora since an information kiosk is available. The project aims to keep its importance and reinforce this point by turning it into a crossroads of spatial and temporal architectural content. To complete the route, two additional points of interest were identified at the exits of the second corridor-axes of the Agora following the cross-shaped structure and, in order to offer the whole experience of the place to the visitor. (Figure 1).
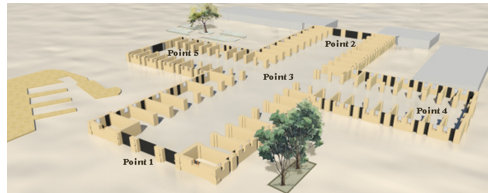

Figure 1
The designed route of the narrative into Agora

ANALYSIS OF EACH POINT ARCHITECTURALLY AND TECHNICALLY

The narrative within the Agora was expressed through the design of five distinct interactive points in the form of a route across the whole building (Table 1).

Point 1: The main entrance

Digital storytelling-narration begins with the experience of three AR implementations to the main entrance (South) of the Agora. Initially, by focusing on the ground in front of the entrance with the camera of the mobile device, the user can have an overall

Table 1
Analysis of each
point
(architecturally &
technically)

ROUTE POINTS	LOCATION	TECHNOLOGY	CONTENT	VALUE
Point 1	Entrance from contemporary town	Marker-based + Markerless AR	3D model + text + 3D video section	Historical +Architectural
Point 2	Exit to old town (north exit)	Marker-based AR - Marker-based Virtual Triggering	3d model + text + hand gesture tracking	Historical
Point 3	Center of Agora (cross of the two corridors)	Markerless AR	3d model of initial building state+ 3d model proposal of a future restoration	Merge historical, functional, materiality and architectural details(timeline)
Point 4	East End	Marker-based AR	Urban Mapping, with roads, facilities and landmarks	Functional, orientation to the city
Point 5	West End	Marker-based AR	Urban Mapping, with roads, facilities and landmarks	Functional, orientation to the city

view of the building and understand the scale and shape of the Agora. Specifically, using the markerless technique of plane detection, an accurate 3D model of the building is displayed on the ground (Figure 2_1b). To highlight and understand the scale of the building, a model of a human figure has been placed at the entrance of the 3D model, signaling the existence of the visitor him/herself in the natural space at the entrance of the Agora. Secondly, by aiming at a facet of the building, the camera detects its shape, displaying a video player proportional to the facet's dimensions and then with a short video playback, a section of the building is highlighted that enables the user to acquire a first impression of the inside(Figure 2_1c). Passing through the main entrance, the visitor finds a specially designed image (image target). Implementing marker-based AR, when the user aims the camera of the mobile device at the image, she/he acquires important information about the history of the building, its materiality and architectural design (Figure 2_1a). As such, the visitor becomes familiar with the dual role of the Agora, as a monument and as a market. Virtual content at this point also acts as a guide to the narrative path, highlighting the chosen route and the locations of other points of interest.

Point 2: Exit of the Agora
The idea of the second point emerged from the fact that during previous research, most users, especially those who did not acquire any information through the digital platform, did not visit the northern part of Agora. Thus there was a need to enhance this point of Agora so that the users could perceive the whole experience of the building and its size. At this point, the aim is to make the users understand the importance of the position of the Agora in relation to its surrounding urban area. The Agora can be considered as a strong link between the new and the old city. It must be stressed that while the main entrance of the building is in the new city, after crossing the building the visitor exits to the old city. Understanding the need to demonstrate this connection, marker-based AR is being implemented. When the camera of the mobile device of the visitor detects the specially designed image, a map of the area emphasizing this link of the old with the new city through the Agora is displayed. Additionally, the visitor acquires historical information about the Agora as a monument. (Figure 2_2a) Moreover, at this location of the building, technology also serves as a means of giving the visitor more time to stay in a place that initially seemed indifferent. Specifically, at this point the user has the ability to experience interaction with the virtual content by activating the hand gesture detection over a Virtual Trigger functionality. To implement a Virtual Trigger, the user passes her/his hand over it, and a 3D model of the Agora appears with additional information about the building as a monument but also about its orientation (Figure 2_2b).
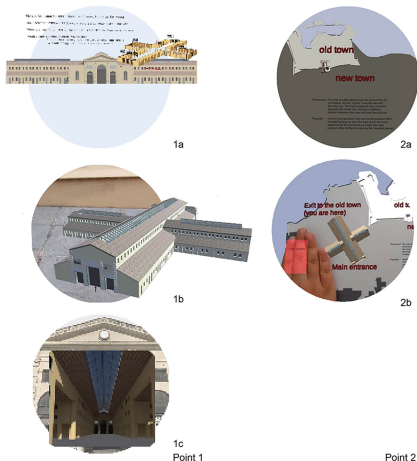
1a

2a

1b

2b

1c
Point 1

Point 2

different areas of the site and display 3D models with architectural information. By turning the camera towards the roof of the building, the user has the opportunity to see the structural features of the roof in its original form (Figure 3_3a). Additionally, focusing the camera towards the wall, the user can see a 3D representation of the current state of the building, revealing illegible morphological features such as the symmetry of the openings of the facades. Finally, by pointing the camera at the opposite wall, a three-dimensional model of a redesigning proposal of the interior of the building is displayed. Figure 3_3b, depicts the display of the architectural proposal on top of the real environment and highlights the initial conceptual approach to focus on the illegible morphological symmetry of the structure of the Agora, as one of its major architectural elements (Figure 3_3b).

Point 3: The center of the Agora

The center of the building is selected as one of the most important points of the route. Currently, an information kiosk constitutes a pole of attraction offering visitors the opportunity to learn more on the building's history. Furthermore, from this location the users can have a panoramic view of the building, but users lack spatial perception and orientation. The perception of the building´s large scale is overshadowed by the narrow corridors resulting from the extensions of the market stalls, preventing visitors from seeing architectural details. To highlight the functional importance of this point, the design of the spatial narrative focuses on strengthening the visitor's perception on the morphological and structural elements of the Agora. Moreover, this point is selected as the point where the interventionist architectural idea of this project is on-site demonstrated to the visitors of the building. Thus, this point, apart from the spatial crossroads, plays the role of the time crossroads, since here with the help of Augmented Reality, parts of the architectural past, present and future of the building are simultaneously experienced. Implementing markerless AR, the visitor has the ability to aim the camera of her/his mobile device to three

Point 4 and 5: East and west ends of the Agora

The points of interest 4 and 5 of the spatial narrative are placed in the second corridor of the Agora (East-west). An important issue of the previous survey (2019) was the difficulty of orienting users not only inside but also outside the Agora. Thus, it was observed that visitors were forced to return to the main entrance of the building to continue their tour of the city, as they did not have enough information about their path if exiting from another exit. Utilizing the new digital level that has been designed, the visitor can better understand the routes of the interior of the building, but also the connection of the Agora with its surrounding area. Points 4 and 5, acting as points of concentrated spatial and urban information, aim to facilitate user orientation regarding the landmarks and facilities of the city of Chania. Point 4 refers to the east exit of the building while point 5 to the west. There, using marker-based AR and through maps, users can understand a part of the structure of the city around the building. When the camera of the user's mobile device detects the specially designed images, maps appear on top of the image, showing specific roads, facilities and attractions. Introducing

Augmented Reality in these places, visitors can continue their journey in the city of Chania, leaving these exits and without having to return to the main entrance. (Figure 3_4a,b).

3a

4a

3b

4b

Point 3

Point 4,5

Figure 3
Point 3, point 4 &
point 5 through AR
application
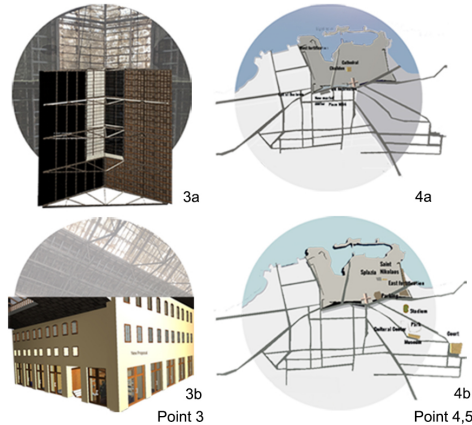
ASSESSMENT AND EVALUATION (OLD AND NEW EXPERIMENT)

The evaluation of the experiment was achieved through a questionnaire that the users completed after their experience within the Agora. The sections of the questionnaires were set around the evaluation of the route, the application, and the enrichment of the users' knowledge (Figure 4) .There are two points which the users appreciated the most. The first point of preference was point 1, the main entrance to the Agora. The fascinating element about this point was that, through AR technology, the users better appreciated the scale, the form of the building and its architectural details. The second point of preference was point 3, the center of the Agora. The superimposing of the states of the building through the application impressed the users and helped them to appreciate the architectural value of the building, such as its symmetry and its spatial difference in comparison to its current state. The main observation of these preferences is that the users appreciated the fact that the building of the Agora was presented as a clear shape without the details of the markets, and this lack of details differentiated and altered the appearance of the whole building. Furthermore, the other points on the route were also given high evaluations by the users. The main purpose of reinforcing underappreciated parts of the Agora, such as the north exit to the old town, was achieved. A great number of users noticed that it was the first time that they had realized the importance of the placement of the Agora and the strong connection between the new and the old town through the main corridor and the north exit. The last two points (4 and 5), situated at the secondary corridor, enabled the users to become more familiar with the surroundings, through the mapping offered by the AR application. The east and the west exits of the Agora lead the user in a buffer zone between the old and the new town. With the aid of the application, the users claimed that they managed to find their bearings concerning the whole city of Chania and to choose how to continue their visits to other city landmarks. In comparison to the aforementioned survey (2019), the authors noticed that the interest of the users was augmented because of the stimuli of the AR technology. The narrative helped the users follow a certain route and thus enjoy the whole building. This guideline was not offered in the previous survey and, as a result, the users avoided places that seemed far from the main entrance or very crowded or with unpleasant odors. One more advantage of the introduction of AR was the ability to orientate oneself. Compared to the users in the previous survey, users of the AR application claimed that the mapping offered by the application helped them find their bearings around not only the Agora but also its surroundings. To summarize, after conducting the experiment and considering its results, the authors observed that the idea of introducing something "new" into something "old" is the optimal stimuli for users and it is an opportunity to attract more people to visit the place. Thus, It is a pleasant way to rethink the monument and collect information on site in real time. The building interacts with

Figure 4
Results of user
evaluation
(questionnaire)
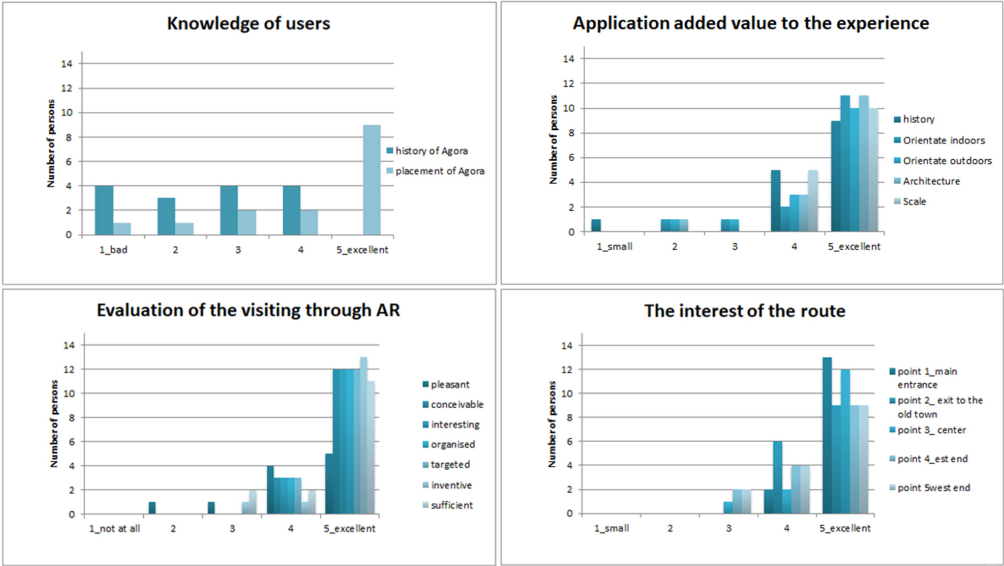
the user and this interaction is more constructive. Furthermore, concerning the crowd and the temperature, the circumstances were better in comparison to the previous survey. The overall assessment was very good and the users showed a great interest in this new narrative with the aid of a new technology.

CREATING SECTION TAXONOMIES

The narrative and the experience of the users within the Agora, defined the spatial trace of the AR technology, discovering a series of taxonomies (Figure 5). Every point of the route had a unique spatial blueprint and the selection of each point intended to recognize and resolve noticeable spatial issues within the space. The chosen tool in order to resolve these issues is AR technology, which alters the user's perception of the space. The choice of the points and the narrative throughout this route achieved the segmenting of the space into individual themes (historical, architectural, functional) but at the same time the defragmenting of the space, thus managing to

highlight the building's dual character. At the design level, the section was used as the tool to define the issues and to appreciate the qualities that the authors wanted to reveal in each point. The section is not used only as a representation technique, but also as a projective tool for digital spatial intervention. The ease of the section process establishes a means to translate the relationship between digital space and material form (Lewis et al., 2016). Each section depicts the internal spatial qualities and presents the immaterial AR intervention and reconstruction. The goal is to present the design initiative, based on the premise of not affecting the physical space of the building. Furthermore, taxonomies are a designed explanation of the spatial narrative and at the same time the narrative itself comes from the emergence of these taxonomies. Each taxonomy shows the main idea of enhancing or highlighting each point and how AR technology is involved.One of the main difficulties that the visitor faces with the Agora is the understanding of its scale, its shape as well as the orien-

tation of the visitor. With the creation of spatial sections and their analysis, the central points in which the alteration of the complete experience of the visitor is felt, are highlighted. Specifically, at point 1 located at the main entrance, the size and shape of the Agora is not easily recognizable by the visitor, so Augmented Reality helps to understand the overall scale. At point 2 low traffic is the key element that needs to be reinforced. So, the visitor is led to visit this point, in order to balance her/his experience throughout the whole building and to facilitate the understanding of the building's relationship with the old city's boundaries. At point 3, despite the fact that the visitor is in the center of a cross shaped building and normally should have an overall picture of the whole space, human intervention (regarding the roof and the extensions of the shops in the corridors) prevents her/him from understanding the size of the space and the geometric and morphological characteristics of the inside of the building. Finally, the axis between points 4 and 5 is illegible in terms of its role as a passage to different parts of the city without the visitor having to return to the main entrance to orient.

Figure 5
Taxonomies
sections for every
point of interest
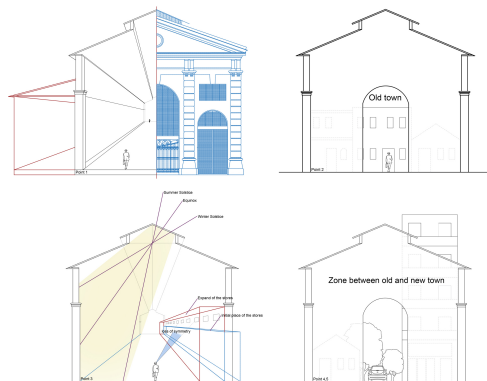
CONCLUSIONS AND FUTURE DIRECTIONS

This paper presents a multidisciplinary approach that superimposes interactive strategies, experience design and architectural analysis towards identifying new design and research methods to enhance user experience in space. Through this superimposition a new experience design scheme emerges: on the one hand, the new digital layer that intends to maximize knowledge, human senses and their development; on the other hand, the section analysis serves as a basis where space, building conditions and material intersect with human experience. This combination of tools - AR and sectional taxonomies - provides a flexible approach to the digital design of the experience within the Building of the Agora. The availability of new technologies offers new, unexplored methodologies of combining architectural design principles with new digital techniques.The way the digital narrative is spatially built is directly related to the way the visitor approaches and experiences the place but also to the particular architectural, spatial and historical characteristics of the building. Although the building is a single object, it looks like it tells two different stories. On the one hand, its historicity which in the eyes of the visitor ceases to be clear and on the other hand its very existence as part of the daily life of the city. The purpose of this project is to design a digitally guided route within the real site that will help visitors appreciate the dual role of the Agora, make them admire the whole building and not just parts of it that are legible and, finally, to reinforce illegible elements that through the division of space into sectors, came to the surface. Starting from the main entrance and utilizing all dimensions of the building, revealing spatial and temporal correlations per predefined area, the experience of the visitor balances and reaches completeness. Thus, a historical and spatial route is set with a beginning, course and ending and the user can understand the nature of the Agora as a building and as a journey but also its importance for the city of Chania. At the technological level, the process of identifying experiential data, combining them with empirical observations and using AR technology as a design strategy that alters the experience without affecting the materiality of the building opens up new possibilities in two discrete fields: firstly AR becomes a valuable user-friendly tool for designing

spatial experiences; secondly, altering user experience without affecting the materiality of the building, yet built on architectural principles promotes the contemporary practice of architecture, correlated and harmonized with technology. Future directions of this work will expand the methodology of creating experimental tools for enhancing user experience in built space and integrate new technologies, design principles and user experience metrics through gamification. By developing a new tool to alter user perception and knowledge on space, the findings of the presented experiments aim to offer insight on how the built environment can become the stimuli to alter and improve human perception and experience of it.

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