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School of Computing
Department of Technology and Aesthetics

AUGMENTED REALITY SPACES: MUSEUMS AND DIGITAL "HETEROTOPIAS"

Jolanta Kolosinska

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Supervisor:
LISSA HOLLOWAY- ATTAWAY

This thesis is dedicated to Yves Gänßinger and Jerzy Antonowicz

who have always been a huge support and inspiration for me.

Thank you.

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Jolanta Kolosinska

Dr. Lissa Holloway-Attaway

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1. Overview

The impact of omnipresent digital technologies within museums cannot be denied. Over the last 30 years, there has been a clear change regarding user experiences and exhibition practices within the structure of the traditional museum. This paradigm shift has been influenced by technological developments, such as the inclusion of handheld devices, social media integration, and digitally-enhanced experiences, for example with Augmented Reality (AR). The traditional museum seen as an institution for the storage of cultural objects is now being challenged by the growing emphasis on education through entertainment (so-called "edutainment") and user-interaction within exhibition spaces and online. Hence we are now in the age of the "Digital Museum." The notion of a Digital Museum, which Russo refers to as a "media museum", was created by the increased usage of new media occurring within the museum environment (145), as well as the changes that museums had to undertake in order to find new ways of generating their own money to make up for budget shortfalls caused by government cuts (Ballantyne, Uzzell 87). This enforced technological development on an institutional level also enable the Digital Museums' visitors to use their own devices, adding a new personal layer to the experience.

In my thesis I examine the changing role of "space" and "place" in contemporary Digital Museums in the context of Foucault's concept of the "heterotopia". According to

Foucault, a heterotopia is a space standing outside of its known place, a space of otherness, which represents society in a distorted way by portraying ideal facets of the culture (24-27). Digital Museums and traditional museums are both heterotopias because they bring together various objects from different times; what distinguishes the Digital Museum is that it juxtaposes those objects with each other through different types of media and technologies hence creating new immersive and enhanced user-experiences. Panorama is an extensive unbroken view of the surroundings, in all directions. Certain kind of panoramas create a deeper level and experience of heterotopia within a Digital Museum. Those are digitally created panoramas accessible through personal devices (smart phones and tablets, for example) and with Augmented Reality applications. These are applications that show, for example, the interior of a building, enhanced by the the body movement of the user who manipulates the device (holding it above his/her head, or turning in a full circle while holding the device. These applications provide a sense of being inside of the building while standing outside and viewing an alternate interior of a space while using AR through the device. For example, by pointing an AR-enabled device upwards, it will show an alternate view of the ceiling, perhaps with new architectural or historical details. I will argue that digital Augmented Reality panoramas are an example of "Digital Heterotopias" that heighten sensory experiences and create a sense of dislocation for users.

In my research I first briefly review the literature relevant to Digital Museums starting with an analysis of key terms: space, place, heterotopia, Augmented Reality and digital panorama, and then I turn to relevant research to create a theoretical framework for identifying digital panoramas as specific kinds of heterotopias within Digital Museums. Finally, the theoretical investigation is supported by a critical experiment with the use of AR Panoramas

as heterotopias to explore the changing role of space/place at a new submarine exhibition at the the national Swedish Naval Museum in Karlskrona.

2. Literature review

2.1 Space and place relation

"Things need to have space (chora)" – Aristotle, Theogony. In classical Greek thought the spatial terms "chora" and "topos" were in use, and although many scholars suggest the correspondence of those terms with "space" and "place", the Greek language did not have a terminological distinction corresponding to differences between place and space concept (Algra 32). Generally, the Greeks envisioned both terms as a kind of location where objects exist. Roland Barthes, applying the concepts from classical Greek semiotics rhetorics, refers to the place (as topos) connecting it to mnemonics: "Why *place*? Because, says Aristotle, in order to remember things it suffices to recognize the place where they happen to be" (65). Places are filled with objects which awake remembrance, which help us to recall it again through the connection between object and subject. Place is also connected to the experience that triggers memories and helps in their remembering.

In the field of sociology, Henri Lefebvre offers two different levels of space: "natural space," which is an absolute space; and "socially produced space." Social space is connected to the very experience of social life; it incorporates social actions and does not have mutually limiting boundaries. The opposite of social space is abstract space which is distinct in the way it is measured: "Abstract space is measurable. Not only is it quantifiable as geometrical space, but, as social space, it is subject to quantitative manipulations: statistics, programming, projections - all are operationally effective here" (252). Abstract space is calculable within its

borders and in its distances. According to Lefebvre, every society produces its own social space, which is fundamental to the reproduction of society. The physicality of space is therefore seen as being socially constructed through interaction within it. Space is seen as not being static. On the other hand, the transformation of space can result in the creation of place, as Tuan indicates: "If we think of space as that which allows movement, then place is pause; each pause in movement makes it possible for location to be transformed into place" (6). Tuan's idea is exemplified in the epilogue of *Space and Place*. *The perspective of experience*:

> We are in a strange part of town: unknown space stretches ahead of us. In time we know a few landmarks and the routes connecting them. Eventually what was strange town and unknown space becomes familiar place. Abstract space, lacking significance other than strangeness, becomes concrete place, filled with meaning. Much is learned but not through formal instruction. (199)

For Tuan space is just limited to geographical location and its contours. As we start to interact in space it becomes more familiar to us and turns into place. Through our movements and experiences in space we construct meanings and create places.

In the field of social computing, Dourish follows Tuan's idea pointing out that "the distinction between space and place is, approximately, a distinction between the physical and the social" (89). According to him, space is the physical structure of the environment, that which is tangible, whereas place refers to the social behaviours constructed in the environment.

To expand with more contemporary reflections on human relationship with space, Barba and MacIntyre use Montello's framework of spatial scales (e.g. see fig. 1). Montello's

framework consist of four categories: figural space, vista space, environmental space, geographical space. However, Barba and MacIntyre claim that: “the immediacy of visual experience,and its importance in AR requires that we add a fifth kind of space (panoramic)” (121). Panoramic space is not visible as a whole without the body movement and since vista space is apprehended from a single place without locomotion, Barba and MacIntyre include vista as a subspace of panoramic space. The importance of panorama to be included in the framework derives from its application to AR, as it is “a technique that can be used to create a virtual space that surrounds a user, but is independent of his position (only orientation matters)” (122). The body rotation allows users to experience panorama’s effect of being in a virtual space without moving from a certain location consequently embodying the experience and deepening the immersion.

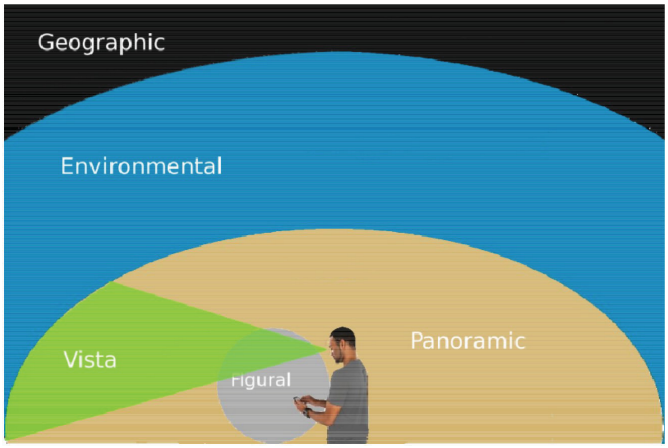

Fig. 1. Barba and MacIntyre model of spatial scales.

2.2 Panorama

“Panorama” is usually understood to be a horizontal, 360 degree overview capturing the circumference of a landscape. Most modern mobile devices and cameras are equipped with the option of capturing panoramic images, which means that the term is commonly used in public. However, panorama may also refer to an analogue technic of capturing the lands-

cape or the view over the lanscape itself. The etymology of the word comes from the 18th century and literally it means “a complete view” (derived from Greek *pan-* “all” and *horama* “a view”). It was used in more modern contexts when describing Rober Baker’s panoramic paintings of Edinburgh and London, and the word was coined by the public to suggest an “improvement to the art of painting” (3). The history of this medium is influenced by technological developments and spreads through photographic, cinematographic, digital and interactive, and video panoramas. Therefore the accurate definition of panorama depends on the specific medium of application.

In the past, panorama was a medium used as a cultural attraction, a form of popular entertainment which Oettermann calls simply a mass medium (X). In *Illusions in motion,* Erkki Huhtamo focuses on the history of the (forgotten) moving panorama, which was a long roll painting presented for the audience by a machine that set it in motion. Huhtamo describes the influence of panorama over the public as their complete immersion made an impression of the travel to another location. Throughout the book Huhtamo underlines the importance of a moving panorama indicating that it had cultural identity of its own. This cultural significance of a moving panorama lays in communicating and creating a globalised experience to local audiences.

Despite the previous reference to panoramic space within a spatial scale, Augmented Reality panoramas have not been explored in depth because of the limited research material available. A deeper understanding of the history of panorama makes it possible to identify significant gaps in the definition of the term within Augmented Reality uses, an emerging area of development and digital design which deals with how information is configured in space. Consequently it is this kind of mixed space which is in the focus of my research.

2.3 Augmented Reality & AR Panoramas

Augmented Reality was first coined by Computer Science. According to Milgram & Kishino Augmented Reality is a subcategory of Mixed Reality (MR). They define MR as a Virtuality Continuum which spreads between the real and virtual environment and where AR refers to "any case in which an otherwise real environment is 'augmented' by means of virtual (computer graphic) objects" (n. pag.). Describing the term with specific examples only, the authors focus on the MR application for visual displays, which can be seen as quite limiting. Azuma on the other hand, identifies AR as a variation of virtual environment and characterises the term by defining it in three criteria: 1) it combines the real and virtual, 2) it is interactive in real time and 3) it is registered in three dimensions (2). Both Azuma and Milgram & Kishino see AR as a mix between the real, physical, environment and a digital, virtually created environment. However Azuma distinguishes the user interaction as a part of AR. This is an important point as AR enhances a user's perception of and interaction with the reality. The third criteria in Azuma's definition of AR is that AR is registered in 3D. As explained by Barbra and MacIntyre, this criterium refers to 3D spaces and models where all of the objects being registered need not be 3D objects themselves but the final space does need to appear as if it is rendered in 3D (119). AR is seen as being not limited to 3D created objects only and can be a representation of another real world presented in a 3D form, like it is with AR Panoramas. AR Panoramas which are in focus of this paper are panoramic photographs of places surrounding the viewer at certain position. This means that they are explored only from the point the photographs were made. There are many different AR browsers available, each of them offering different panoramic views and features. In some applications panoramas are explored by sliding movement on the screen. In my research, I focus on the Argon AR browser (created in the Augmented Environments Lab at Georgia Tech in Atlanta, USA) which offers a more

intense and embodied user- experience, as the panorama is explored through the full-body rotation of the user.

2.4 Augmented museums

The integration of modern technology into everyday life influences contemporary architecture. The embodiment of digital information can be seen in public spaces, such as city malls or museums, which are filled with screens, transparent multimedia projections, sounds, etc. In *The poetics of augmented space* Lev Manovich approaches those spaces focusing on their aesthetic and cultural values. According to him, augmented spaces are spatial forms which are overlaid with dynamic multimedia information (1). Additionally, the connection between surveillance and tracking technologies, and information data in public spaces are both connected to the concept of augmented space (3-5). While Manovich describes how spaces are augmented by media I will focus on the media which augment the space in the form of AR technology.

AR technology has been successfully used in museums environments in recent years. In 2007 Schmalstieg and Wagner present their results of a complete handheld AR framework with multi-player treasure hunt games that were used in a museum space. Wagner wrote also a very comprehensive paper on handheld AR, where he describes technical details of AR applying it to mobile devices (2007). Bruns et al. (2007) and Lee & Park (2007) use mobile phones for AR-based museum information and guidance systems for the visitors. These works were based on marker tracking or image/object recognition. However, the improvements in tracking systems made relevant changes in object position estimation and the markerless tracking, like hybrid tracking, is becoming more popular (Reitmayr and Drummond, 2006) (Miyashita et al., 2008).

AR is dependent on the location and in general, there has been two main trends in using AR based on the location: tight registration to places (e.g. GPS, Wifi) and tight registration marking (e.g. 3D graphics appearing on the objects). Using AR location based technology introduces a new dimension to museum environments. AR challenges the augmentation of the museum space using exact positioning. It brings two different disciplines together growing even stronger outside of Computer Science field.

2.5 Redesigning the space

While Manovich discusses how people are being exposed to surrounding them transparent multimedia environments, other researchers explore the ways in which audiences influence their surroundings. Research conducted by Diamantopoulou et al. through the observation of museums' visitors, focuses on visitors usage of a digital camera (120-123). While exploring the exhibition users often decide to take photographs of some of the objects presented. These photographs are taken in order to remember the information presented in the exhibitions, depending on users' interests. The visitors are selecting and framing aspects of the exhibition which results in the shaping of their own understanding of the space. In this process the museum path is customised and resists the formal museum constraints, leading the visitors through the space in ways that they determine. This process is referred to as redesigning practice in which the use of the digital camera offers the possibility for recreation of the exhibition space (112).

Photography-based social media platforms are also commonly used within museums walls (Hillman, 2012). While using social media for documenting their experiences, users are creating digital archives of information which could be easily accessed online. Museums spaces are therefore being constantly rebuilt by their audiences, which take an opportunity to

capture the moment as it happens, and thus giving a new meaning to the space. This practice could be described as archiving of the information about spaces. Roger I. Simon explores the concept of archiving personal experiences which he refers to as just "remembrance" (101). According to Simon, the social form of memorising (or remembering) is giving the public opportunity for changing the history collectively (the concept of historical presence). People want the memory of certain events and occurrences to be alive in the online world, archived forever for the future audiences in newly created digital space.

3. Museum as heterotopia

3.1 The otherness

As I have outlined above, the differences between space and place indicate close relationship between both terms. Agnew refers to Elden by stating that "the project of a spatial history that can be associated with Heidegger and Foucault depends fundamentally on relating place to space as if they are internally related to one another" (319). Foucault, being one of the most significant social theorists, proposed a new concept of an external space. In *Of Other Spaces* he distinguishes his work from Bachelard's work on internal space, where he *"*taught us that we do not live in a homogeneous and empty space, but the contrary in a space throughly imbued quantities and and perhaps thoroughly fantasmatic as well" (23). Foucault is interested in two kind of spaces: "utopias" which are the sites presenting society in a perfected form, and "heterotopias", which are real places standing outside of known places (24). He uses the reflection in a mirror as an example. In this case the mirror itself is an utopia (placeless place) but the reflection in it is a heterotopia, since it is present in the place of otherness: "I see myself there where I am not" (24). Heterotopias are divided into two categories: crisis heterotopias, which are reserved for special groups within the society, and heterotopias of de-

viation. Foucault argues that each heterotopia has its function within a society and is a part of every culture. There are certain kinds of heterotopias which are juxtaposed in a single space other spaces (for example, moving panoramas). Another principle relates to time, where a heterotopia separates us from our usual time. Further on, heterotopias are described as always maintaining a system of opening and closing, which makes them both isolated and accessible. As the final aspect, the author mentions the relation of heterotopia to other existing spaces. They are either spaces of illusion, of which brothels is an example as it depicts a truly delusory existence, or spaces of compensation, like 19th centuries English Colonies which strived to construct a perfect new world. According to Foucault, the boat is the heterotopia "per excellence", since it is a floating piece of space not fixed to any other place (27). Moving between fixed points on the land, the ship functions according to it's own rules, choosing itself at which port should it stop and what should be taken onboard.

3.2 Museum space

Traditional museums are spaces filled with objects. All of those museums "are defined by an arrangement of objects in space that requires the visitor to walk" (Kirshenblatt-Gimblett, 4). The traditional view of museums describes them as spaces filled with objects. However, this traditional point of view does not consider any aspects of interaction which transforms museums spaces into cultural places. Mobility characterises museums, as they are spaces which, through visitors' interaction with exhibited objects, become familiar places. The exhibits determine therefore the nature of museums. Visitors' interaction and experiences within museums' places are only partly dependent on the institution. Partly, as even though the path is carefully planned and visitors are navigate from one point to another, museums are not static spaces. Visitors are redesigning the planned route in their own, uncontrolled way by

choosing themselves where to go and what to see (Diamantopoulou et al., 2012). Also, the exhibits displayed in the museums and information about them are being redesigned by the augmentation surrounding their environment, which is yet another example of the museums' variable nature. Museums' visitors do not only interact with exhibited objects; the space and other visitors within it are also part of a process of interaction, which transforms unknown space to familiar place. The social relations between institutional space and visitors are changing.

Museums are also places featuring past-to-present audiences. The exhibits are taken away from their original space and time. They are all decontextualised and re-connected in a new environment, brought to a new timeframe. Not only do the spatial forms of museums represent contemporary views, but also visitors themselves are agents of current time. Museums are institutions disconnecting visitors from current moments, hence creating the juxtaposition of time within space.

3.3 Foucault's museum

According to Foucault, heterotopias are not fixed in time or space, they function in non-hegemonic conditions and respond to societal needs. The first principle of heterotopia is that "there is probably not a single culture in the world that fails to constitute heterotopias" (24). Heterotopias are part of every culture, though they are made manifest in different ways. For example, hospitals and schools may be designed and integrate in a culture dependent on different values, politics and ideologies. There are two kinds of heterotopias: heterotopias of crisis or heterotopias of deviation (24-25). According to Foucault, crisis heterotopias are reserved for people who are in a state of crisis, when compared to the state of society they live in, like pregnant women or elderly people. On the other hand, heterotopias of

deviation are represented by individuals whose behaviours violate established norms or rules (an example of such space would be a prison). The Museum does not belong to any of these two categories. However, it is defined by the International Council of Museums as a permanent institution in the service of society and its development. Museums' fundamental purposes, for education, study and enjoyment, are clearly gaining more importance nowadays challenging the primary categories of heterotopia.

The second principle of heterotopia says that "a society (…) can make an existing heterotopia function in a very different fashion; for each heterotopia has a precise and determined function within a society (…)" (25). Looking back at the history, early museums began as private collections, accessible only by the middle and upper classes, whereas nowadays they are open for the broad public. With the change of the primary audience the function of the museum has changed, and modern museums offer variety of choices to their audiences, from art museums displaying artefacts to science museums filled with experimental machines. Throughout history the role of the museum has always responded to the needs of society, having specific operations at different point in history and therefore fulfilling the second principle of heterotopia.

According to the third principle "the heterotopia is capable of juxtaposing in a single real space several spaces, several sites that are in themselves incompatible" (25). The following principle is probably the most relevant one for the museum. The very first public museums were defined as institutions for the storage of cultural objects, buildings which brought objects from the past into one place in order to present them to current audiences. Even though the recent paradigm shift has changed museums' perception influencing its definition, modern Digital Museums still remain buildings for storage as they collect and display objects which do not belong to the space they are being presented in. For example, the British

Museum's permanent collection dedicated to human history and culture, contains about 8 million works from all continents being the largest one in the world. The British Museum gathers in it's walls historical and cultural objects collected from different places and brought together into one space. This juxtaposition happens not only in space but also in time, which is another principle of heterotopia, according to which museums and libraries are examples of heterotopias which accumulate time, places where the time never stops building up (26). Further on, Foucault argues that the idea of accumulating everything and the will to enclose in one, immobile place all times, belongs to our modernity (26). An example of such a museum is Deutsches Museum- the biggest science centre in Germany. In its exhibitions visitors are presented with the history of important to humanity inventions belonging to categories like transport, natural sciences, energy, etc. The gathering of objects from different time periods serves mostly for educational purposes, and it is a very common practice used to attract more visitors.

The fifth principle of heterotopia states that "heterotopias always presuppose a system of opening and closing that both isolates them and makes the penetrable" (26). Museums are not freely accessible public places, since they demand certain kind of permission in order to be reached. Museum visitors need to gain access by purchasing or obtaining access. Even digital museums contain systems of opening and closing, like a digital application available only for certain kinds of phones. Museums are isolated from their surroundings, but at the same time, they remain unique. It is the inability of accessing museums with a particular ease that increases their status in the society.

As the final aspect, the author mentions the relation of heterotopia to other existing spaces. They are either spaces of illusion, of which brothels is an example as it depicts a truly delusory existence, or spaces of compensation, like 19th centuries English Colonies which

strove to construct a perfect new world. The sixth and the last principle of heterotopia is that it has "a function in relation to all the space that remains" (27). This relationship to other places creates an unrealistic image which stresses their inexistence elsewhere. Yet heterotopia remains a real space which is artificially constructed and which creates the feeling of illusion or compensation. Museums create an imaginary order, non existing scenario which evokes the feeling of compensation in the audience. Museums' visitors are faced with a particularly constructed order of things which serves to educate, inform and even entertain.

Ideas formulated by Foucault more than 25 years ago still remain relevant to modern times. However they need to be slightly modified in order to fully respond to all of the changes which have appeared in the society. Our society has shifted towards a more mediated culture and we are leaving in mediated places. Following the concept of the museum as a heterotopia, the paradigm shift within museum structure has to be taken into consideration. For instance projects such as the "Google Art Project" -an online platform making the high resolution images of selected artworks accessible to the public all around the world- is an example of Malraux's vision of the "musée imaginaire" or "museum without walls" (1949). Although Malraux's vision referred to more of a visual mental storehouse, the "museum without walls" refers to a space that makes its information and knowledge available to the visitors within it, as well as for those distanced from it. Along with the expansion of the museum outside of its walls through the increased usage of new media technologies within the museum environment, the notion of the Digital Museum emerged. The expectation of interaction is a crucial part of the development of the Digital Museum, where even a seeming lack of interaction is a process of visitors' redesigning the path which was carefully planned to interact with. As long as the visitors are present in Digital Museum space, they automatically interact with it. Foucault's vision of the heterotopic museum did not include a category of the Digital Muse-

um. Nevertheless, written more than 25 years ago, the principles of the heterotopia allow one to define the emerging Digital Museum as a heterotopia.

4. AR Panoramas as Digital Heterotopias

Argon AR browser offers a more intense and embodied user-experience, as the panorama is explored through the full-body rotation of the user. Panoramas created in Argon are a "collection of perspective-adjusted images placed in a form of a box around the user" (Barbra and MacIntyre, 126). They are accessed through the devices' camera. However, they do not blend reality with virtuality directly. The device shows a 3D-rendered full view photographic panorama of a physically existing space, but the device does not close the user's vision from the surroundings which spread outside of it. The AR Panorama combines the real and virtual, where virtual representation is visible on the device and physical environment is seen outside of it. Because AR technology is closely tight to the location, AR Panoramas may be accessed in a certain location only, depending on the chosen method of registration. They can be accessed through tight registration to places using e.g. GPS location, or triggered by a marker, e.g. an image which location can be easily changed, but still AR Panorama location will be determined by the image placement.

As Barbra and MacIntyre point out "AR experiences are only possible in figural and vista spaces where the entire space is perceptible from one vantage point" (124). AR panoramic experiences persist visually and because human vision does not extend beyond panoramic space, the interaction with AR technology cannot happen outside of the panoramic space. The AR Panorama technology used by Argon browser requires user's interaction which can only happen in the surrounding environment. The rotation of the body allows for the am-

bient environment exploration and interaction with it. The augmentation of the space by the device with the usage of AR technology clearly influences the user's perception of the panoramic space.

Through AR Panorama in Argon browser the user explores a digital space which is not necessarily fixed to the location it is accessed at, while at the same time, the real environment spreads around the user. The juxtaposition of these two different spaces creates a sense of dislocation and even confusion in the user who interacts with the device. The user explores 3D rendered digital space, which may not even exist in reality, but with time this space becomes more familiar and transforms into a place. The interaction within unknown space transforms it into a familiar place. It happens because AR Argon browser allows for the embodiment of the digital space through the physical interaction between the user and the device. What the user sees on the device becomes now a place which is localisable where the user accesses it. It is visible on the device's screen, for the interactor only. It is an intimate place, a place of otherness which I call a "Digital Heterotopia".

Heterotopia is a space defined by the object and people within it. It is the experiences and interactions in that space which characterise it. However, discussed already in detail Foucault's definition of heterotopia does not take mediation into consideration. This is an important issue as digital devices are only agents for Digital Heterotopias. Foucault is conscious that "no one absolutely universal form of heterotopia would be found" (1984). This statement encourages me to expand the definition of heterotopia, adapting it to modern times. Like museums, Digital Heterotopias do not belongi. to the category of deviation or crisis heterotopias However, they do have a specific function within a society which I also believe is similar to the function museums have. They are used by artists, institutions and companies as tools for entertainment, education and advertisement. As well as heterotopias, Digital Heterotopias jux-

tapose time and space within themselves, but can be accessed only through the agency of digital devices, which means that they presuppose the system of opening and closing. The relationship between accessed through the device Digital Heterotopia and the space surrounding it is the most important trait of Digital Heterotopias. The placement of the digital environment in the real space allows for the interaction between two spaces and augmentation of the reality. At last, Digital Heterotopias demand user interaction. They are not freely accessible spaces, which can be passed through without noticing. They demand the user's mediation, which is indicating the physical interaction in itself.

5. Conclusion

Media *are* our situation (Mitchell and Hansen, 2010). We are no longer a culture of media, our culture is media. The mediation of everyday life is our condition. Technology shapes our world influencing the environment we live in and giving room for new spaces. Public places such as museums are great examples of how technology affects both space and human being. Traditional museums, Digital Museums or so-called "museums without walls" (Malraux, 1949) are all spaces standing outside of their own space, they are heterotopias. They are places filled with objects, perfectly arranged in order to enhance visitors' experiences. The practice of the conscious augmentation of the place characterises museums. The usage of Augmented Reality technologies such as the AR panorama in the Argon browser within the museums' environment adds yet another layer of a heterotopia created within an already augmented places. These AR panoramas are examples of Digital Heterotopias that heighten sensory experiences and create a sense of dislocation for the museums' visitors. They are con-

structed to enhance visitors experiences through intimate and immersive interactions that evoke the illusion of being somewhere else.

In order to gain deeper understanding of the changing role of space and place and its influence over human being, I created a critical experiment with the use of AR Panoramas in Argon browser at a new exhibition focused on submarines at the Naval Museum in Karlskrona. Using an AR panorama to enhance the experience of being “inside” a submarine, I allowed users access to an alternate view. The artifact exemplifies what I have described in my research as an embodied and customized relationship between museum visitors and the spaces created by Digital Heterotopias inside museums. In the technical report, appended following this essay, I outline the specifics of my project more completely and explain its relevance to my research.

6. Works Cited

Agnew, John. "Space and Place." *The SAGE Handbook of Geographical Knowledge.* Eds. Agnew John and Livingstone David. London: Sage, 2011. Print.

Algra, Keimpe. *Concepts of space in Greek Thought*. Leiden: E.J. Brill., 1994. Print.

Azuma, R. "A survey of Augmented Reality." *Presence: Teleoperators & Virtual Environments*, *6.*4, MIT Press, 1997. 355-285. Web. December 2013.

Ballantyne, Roy, and David Uzzell. "Looking Back and Looking Forward: The Rise of the Visitor−centered Museum." Curator: The Museum Journal 54.1 (2011): 85-92. Web. 10 February 2014.

Barba, Evan, and Blair MacIntyre. "A Scale Model of Mixed Reality." *C&C '11. Proceedings of the 8th ACM Conference on Creativity and Cognition.* New York: ACM, 2012. 117-126. Print.

Barthes, Roland. *The Semiotic Challenge.* New York: Hill and Wang, 1988. Print.

Bruns, E., et al. "Enabling Mobile Phones to Support Large-Scale Museum Guidance." *IEEE MultiMedia 14.2.* IEEE, 2007. 16–25. Web. 13 March 2014.

Dourish, Paul. *Where the Action is: The Foundations of Embodied Interaction*. Cambridge, Mass: MIT Press, 2004. Print.

Elden, S. *Understanding Henri Lefebvre: Theory and the Possible.* London/New York: Continuum, 2004. Print.

Foucault, Michel, and Jay Miskowiec. "Of Other Spaces." Diacritics 16.1 (1986): 22-27. *JSTOR*. Web. 1 February 2014.

Hillman, T., et al. "Creating live experiences with real and stuffed animals: The use of mobile technologies in museums." *The Transformative Museum*. Ed. Kristiansen, E. Odense: DREAM, 2012. 138-149. Web. November 2013.

Huhtamo, Erkki. *Illusions in Motion: Media Archaeology of the Moving Panorama and Related Spectacles*. Cambridge Massachusetts: MIT Press, 2013. Print.

Kirshenblatt-Gimblett, Barbara. "*The Museum-A Refuge for Utopian Thought." New York University.* n.d. Web. 29 March 2014. Accessed at: http://www.nyu.edu/classes/bkg/web/museutopia.pdf

Lee, Dong-Hyun, and Park Jun. "Augmented Reality based museum guidance system for sel ective viewings." *Digital Media and its Application in Museum & Heritages.* IEEE, 2007. 379 - 382. Web. 13 March 2014.

Lefebvre, Henri. *The Production of Space.* Trans. Donald Nicholson-Smith. Cambridge, MA: Blackwell Publishing. 1991. Print.

Malraux, Andre. *The Psychocolgy of Art. Museum Without Walls.* New York: Pantheon Books, 1949. Print.

Manovich, Lev. *The Poetics of Augmented Space: Learning from Prada.* n.p. 2005. Web. 10 May 2014.

Milgram, Paul and Kishino Fumio. "A Taxonomy of Mixed Reality Visual Displays." *IEICE Transactions on Information Systems*, Vol E77-D, No.12. 1994. Web. December 2013.

Mitchell, W. J. T. and Hansen Mark. B. N. "Introduction." *Critical Terms for Media studies.* Eds. W. J. T. Mitchell and Mark B. N. Hansen. Chicago, London: The University of Chicago Press, 2010. Print.

Miyashita, T., et al. "An Augmented Reality museum guide." *Mixed and Augmented Reality, 2008. ISMAR 2008.* IEEE, 2008. 103-106. Web. 13 March 2014.

Oettermann, Stephan. *The Panorama: History of a Mass Medium*. Cambridge: MIT Press, 1997. Print.

Reitmayr, G. and Drummond T.W. "Going Out: Robust Model- Based Tracking for Outdoor

Augmented Reality." *Proceedings of ISMAR 2006.* IEEE, 2006. 109-118. Web. 13 March 2014.

Russo, Angelina. "The rise of the 'media museum'. Creating interactive cultural experience through social media." *Heritage and Social Media: Understanding Heritage in a Participatory Culture*. Ed. Elisa Giaccardi. New York: Routledge, 2012. 145-158. Print.

Schmalstieg, D. and Wagner D. "Experiences with Handheld Augmented Reality." *Proceedings of ISMAR 2007.* IEEE, 2007. 3-15. Web. 13 March 2014.

Silberman, N. and Purser M. "Collective Memory as Affirmation." *Heritage and Social Media: Understanding Heritage in a Participatory Culture*. Ed. Elisa Giaccardi. New York: Routledge, 2012. 13-29. Print.

Simon, Roger. "Remembering Together: Interactive Social Media and the Formation of the Historical Present." *Heritage and Social Media: Understanding Heritage in a Participatory Culture*. Ed. Elisa Giaccardi. New York: Routledge, 2012. 89-106. Print.

The International Council of Museums, Museum Definition, n.d. Web. 26 March 2014. Accessed at: http://icom.museum/the-vision/museum-definition/

Tuan, Yi-Fu. *Space and Place: The Perspective of Experience.* Minneapolis, Minn: University of Minnesota Press, 1977. Print.

Wagner, D. *Handheld Augmented Reality (Dissertation).* Graz University of Technology, Institute for Computer Graphics and Vision: Graz, 2007. Web. 13 March 2014.

Notes From

Fig. 1 Barba, Evan, and Blair MacIntyre. “A Scale Model of Mixed Reality.” *C&C ’11. Proceedings of the 8th ACM Conference on Creativity and Cognition* (New York: ACM, 2012) 121. Print.

Augmenting the Neptun

Panoramic Experiences for Naval Museum Karlskrona

Jolanta Kolosinska
Blekinge Tekniska Högskola,
Karlskrona, Sweden.

Introduction

This project report is a part of my Bachelor Thesis titled "Augmented Reality Spaces; Museums and Digital "Heterotopias" in which I explain the practical applications of my thesis. The project is a result of cooperation between Blekinge Institute of Technology (BTH), the Augmented Reality Lab at Georgia Institute of Technology and the Naval Museum Karlskrona, where the academic partners from both universities (Jay David Bolter, Maria Engberg, Jolanta Kolosinska, Carlotta Scalet and Lissa Holloway-Attaway) provided the technical solution for the new exhibition at the museum. The exhibition which opened on the 6th of June 2014 is build around 110 years of the swedish submarine history. Two vessels are in focus: HMS Neptun from the Cold World era and the Swedish Navy's very first submarine Hajen which came into service in 1904. The visitors have a great opportunity to get in very close contact with the history by going on board the Neptun. However, the chance to explore the interiors of the real submarine is limited, as people with certain disabilities, like for example claustrophobia or immobility by wheelchair restrictions, may not be able to get on board. The project's core component is a digital recreation of the Neptun's interior with the use of digital panorama technique. Augmented Reality (AR), is a technology enhancing the view of reality with digital information being interactive in real time and registered in three dimensions [1]. The aim of the project is to digitally recreate the inside of the Neptun using both AR panoramas on handheld devices and its desktop computer equivalent.

The paper begins with a short description of the submarine hall, which gives an overview of the project's environment and identifies some of its restrictions. Further on, I explore the theoretical context of the project identifying the designers motivations and intensions. The next part describes each of the project's components. Finally, I present the feedback received from the audience and museum curators during the exhibition grand opening, before I proceed to sum up the paper in the conclusion section, where I indicate the connection between the theoretical and practical components of my thesis.

Inside the submarine hall

The submarine hall in the Naval Museum Karlskrona is a project which took seven years of planning and execution before it was finalised in 2014. The building is a small, rather dark space which resembles the mystery that has always been surrounding the submarines. Its architecture is inspired by the production of Karlskrona Visby corvettes, which are invisible to radar and defense installations. The exhibition is filled with a secretive atmosphere, as the use of the allegoric placement of the two most significant swedish submarines inside the "invisible" corvette's body strikes the visitors with the Swedish Navy's power and authority.

The exploration of the Neptun's interior happens at two levels. Situated on the ground floor of the vessel part of the exhibition can be freely accessed by the visitors whereas to get onboard the upper floor the visitors must purchase extra tickets. Because of safety reasons the amount of people visiting the Neptun at the same time is limited. This results in queues which

may be problematic for the visitors with small children. What is more, there is only a certain amount of free places for the extra paid tour which takes place at certain times of the day only. This may be a cause of the disappointment coming from the visitors who are restricted by the time schedule, or who simply did not get a a free spot and miss a chance of seeing one of the main attractions. Needless to say, the extra payment of 40sek could be a restriction of its own.

The audience in focus

Omnipresent digital technologies are unavoidably influencing the spaces we live in. Public spaces, of which museums are an example, are forced to catch up with new trends in order to attract their visitors. This is also caused by a constant decrease in governments financial support for non-formal education institutions, where institutions such as museums are becoming more dependent on profit coming up from the visitors (entrance fees, souvenirs) [2]. According to Ballantyne and Uzzell these changes within museums structure are creating "the visitors-centred museum" where museums are devoting much effort for exploring visitors motivations and needs as their role is crucial for financial stability.

The visitors-centred museums are also institutions responding to emerging technological changes. The probability that the visitors are equipped with multifunctional handheld devices, such as smartphones or tablets, is not only high but is constantly rising. Museums are therefore motivated to keep up with the ongoing changes happening within the society. The visitors are expecting more interaction and "edutainment" values (education and entertainment) become an essential part of the museum's exhibitions. The described changes deeply effect museums on both content and design levels, but however challenging the technological developments may be, they also offer a wide range of possibilities.

Personal, handheld digital devices such as smartphones or tablets offer a very intimate relation between the user and the device. They are often used within museums walls for documenting practices which influence the visitor's depiction of the museum space [5]. This practice of documenting one's own experiences and views on the exhibition results in a redesign of a museum space [4]. Museum visitors create their own private spaces while interacting with their personal devices. The observation of this phenomenon offers an opportunity for museums to respond to their audiences' needs by offering them the exploration of the additional digital information. The panoramic project we conducted at the Naval Museum Karlskrona's new exhibition is designed to respond to the special audiences needs. First of all, it is directed at people incapable of entering the Neptun because of their physical and mental disabilities, or because of explained in the "Inside the submarine" section restrictions like lack of finances or time. Finally, the project responds to audiences needs of the usage of their private handheld devices being a part of the redesigning of the museum space practice. The project is therefore on one hand mimicking the experiences occurring onboard the Neptun, while on the other hand, it offers a slightly different more private and edutainment experience for the visitors who have already seen the inside of the vessel.

Project description

The core part of the project is a digital panoramic experience displaying the interior of the Neptun submarine which happens at two different points: in the dining room at the ground floor and in the command bridge situated on the upper floor. The images below present the Neptun's plan where the red icon indicates the camera placement:

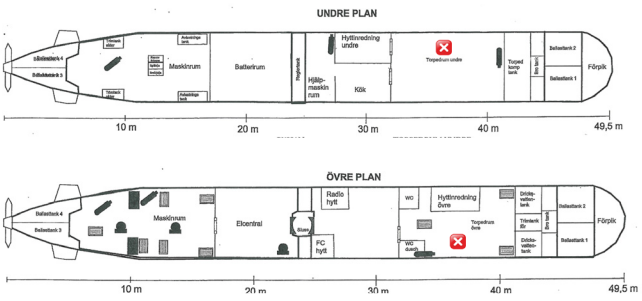

Figure 1: The Neptun's plan

The panoramas can be accessed by the public in two different ways: with the Augmented Reality (AR)

browser Argon, which was developed by the Augmented Reality Lab at Georgia Institute of Technology for iOS devices only, or on the web browser which functions on most of the handheld devices and desktop computers. Argon is an AR-browser with open-standards and it is designed using HTML5, CSS3 and JavaScript. The panoramic experience through Argon is an intense and embodied user-experience in which the Neptun's interior is explored through the full-body rotation of the user. It is seen through the device's camera, however it does not blend the virtual information with the reality as it is a "collection of perspective-adjusted images placed in a form of a box around a user" [3]. While the user is immersed in the exploration of a digital world seen outside of the device the real world surrounds him. In that way the AR panorama mixes the virtual and real world. The web browser based panoramic experience is created based on an open source JavaScrip library called three.js. In the browser the viewer will see a slowly rotating panorama which can be explored through the cursor or finger movements (depending on the type of the screen). Both the AR and the web browser panoramic experiences are accompanied by the auditory storytelling, but while two AR panos are accessed separately, the web browser pano is a continue experience where two panos are linked with each other.

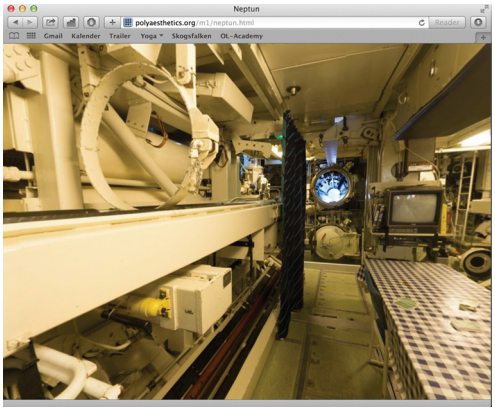

Figure 2: Panorama screenshot in the Safari browser

The project includes also other components, one of which is a teaser for the exhibition- an interactive HTML5 website created from a CMS template on Squarespace platform. It presents the photographs taken by the Naval Museum's photographer -Erling Klintefors, which are displayed on the fullscreen and only the white stripe of the navigation bar is seen on the bottom. The website is divided into 3 main sections: the Neptun's transportation to Stumholmen island; its restoration; and the creation of the submarine hall building. It is a photographic storytelling platform, where image captions serve as a narrative. As the photographs are depicting the history of the submarine hall the aim of the website is to use this archived information to show the creation of this incredible project. At the same time, the website is not a part of the exhibition content, it is extra material which can be looked at in the museum while waiting to get to the exhibition venue (only 200 people can be inside the submarine hall at the same time) or at home before and after the visit in the museums.

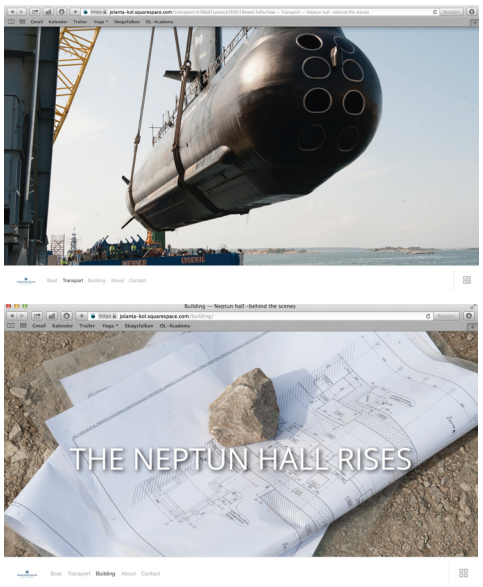

Figure 3: Website screenshots in the Safari browser

Another project component which is at its very first stage of the development is an Augmented Reality experience for the Hajen submarine. The Hajen is the Swedish Navy's first submarine, yet it remains in the shadow of the magnificent Neptun. The visitors of the exhibition are not allowed to get onboard Hajen, what is more not many information about the vessel are provided. The AR-experience we are working on aims at presenting the inside of the Hajen. This is a location based experience that uses Argon browser for iOS

devices in order to map an image of the inside of the submarine onto its shape. It's achieved through the device's camera, where the digital image is overlaid on the reality.

Figure 4: The Hajen seen in reality and with AR (prototype)

Further developments

The whole project team was present at the grand opening of the submarine hall which took place on the 6th of June 2014. We introduced two panoramic experiences to the public for the first time. Since the usage of AR technology is not very common, almost all of the visitors which interacted with the project saw AR panoramas for the first time in their lives. Not only all of the responses were positive, but many of the visitors openly acknowledged the importance of the project. Our audience at that day included inter alia the main target groups: families with small children, disabled people and elderly people.

Fig. 5: Talking with the disabled Neptun's veteran

Some of the visitors were curious of why we did not create the same experience for the Hajen submarine, which only reaffirmed us of the need for further development of the project. Our presence at the grand opening was a very important factor for the project. It was arranged by the Naval Museum which now is able to analyse the visitors responses in order to identify their needs before the project will become a part of the exhibition.

Conclusion

The panoramic experiences offer a great opportunity for both mimicking as well as accessing existing reality places. By doing so they create new, private and intimate places for users who interact with their digital handheld devices in real environments. The ways in which people use new technology in museums' places affects them. The visitors-centred museums are "media museums" [6] in which the meaning of concepts of "space" and "place" are being constantly challenged. The AR panorama in Argon browser is an example of a "Digital Heterotopia" that enhances visitors experiences through immersive interactions which evoke the illusion of being somewhere else, at the same time heightening sensory experiences and creating a sense of dislocation and confusion for users. The concept of Digital Heterotopia is explained in the theoretical component of my thesis titled "Augmented Reality Spaces; Museums and Digital "Heterotopias".

References

1. Azuma, R. "A survey of Augmented Reality." *Presence: Teleoperators & Virtual Environments*, *6*.4, MIT Press, 1997. 355-285. Web. December 2013.
2. Ballantyne, Roy, and David Uzzell. "Looking Back and Looking Forward: The Rise of the Visitor−centered Museum." Curator: The Museum Journal 54.1 (2011): 85-92. Web. 10 February 2014.
3. Barba, Evan, and Blair MacIntyre. "A Scale Model of Mixed Reality." *C&C '11. Proceedings of the 8th ACM Conference on Creativity and Cognition.* New York: ACM, 2012. 117-126. Print.
4. Diamantopoulou, S., et al. "Making meaning in an exhibition: Technologies, agency and (re-)design." *The Transformative Museum*. Ed. Kristiansen, E. Odense: DREAM, 2012. 110-127. Web. November 2013.
5. Hillman, T., et al. "Creating live experiences with real and stuffed animals: The use of mobile technologies in museums." *The Transformative Museum*. Ed. Kristiansen, E. Odense: DREAM, 2012. 138-149. Web. November 2013.
6. Russo, Angelina. "The rise of the 'media museum'. Creating interactive cultural experience through social media." *Heritage and Social Media: Understanding Heritage in a Participatory Culture*. Ed. Elisa Giaccardi. New York: Routledge, 2012. 145-158. Print.