Engineering Augmented Tourism Experiences

Zornitza Yovcheva[a], Dimitrios Buhalis[a] and Christos Gatzidis[b]

[a]School of Tourism
[b]School of Design, Engineering and Computing
Bournemouth University, United Kingdom
{zyovcheva, dbuhalis, cgatzidis}@bournemouth.ac.uk

Abstract

Technological innovation in the tourism domain represents not only an important source of economic growth but also the means to satisfy an ever-growing demand for unique tourism experiences. The potential of Augmented Reality (AR) systems to enhance the on-trip experience of tourists is by far unmatched by other types of displays. There is still very limited research that deals with the various aspects of augmented tourism experiences. This paper contributes to eTourism literature in three ways. First, a conceptualization of augmented tourism experiences is presented. Second, the main characteristics of augmented tourism experiences are described. Third, this paper outlines a framework that captures the most significant determinants of augmented tourism experiences. The main aim is to set directions for further research but also to provide tangible help for developers and designers to engineer augmented tourism experiences.

Keywords: Augmented Reality, eTourism, tourism experiences

1 Introduction

It has long been recognized that the adoption of emerging new Information and Communication Technologies (ICTs) within the tourism domain nurtures competitiveness through enhanced operational efficiency and fast service failure recovery (Kandampully et al., 2001; Buhalis & Law, 2008). More recently, significant attention was directed towards technological innovation that is capable of satisfying a very significant societal and individual demand for memorable experiences (Tussyadiah & Zach, 2011). The visualization potential of AR to enhance on-trip experiences of tourists is by far unmatched by other displays. Many application areas already enjoy the strengths of AR in order to display information about visible (unfamiliar) objects immediately in context, resulting in better situation awareness (Livingston et al., 2011). For instance, in military scenarios (Livingston et al., 2011) AR systems are used to highlight potentially dangerous areas, buildings or streets.

Tourism features as a promising domain for utilizing AR in many reviews (e.g. Höllerer & Feiner, 2004; van Krevelen & Poelman, 2010) and has been a target application area in many early (Feiner et al., 1997; Vlahakis et al., 2001; Papagiannakis et al., 2005) and more recent (Luley et al., 2011; Linaza et al., 2012) AR studies. Such studies however do not adequately address the specific benefits and issues associated with AR use in the tourism domain. In terms of benefits, it is generally accepted that AR changes the experiences of its users. Empirical evidence suggests that it is not uncommon that such changes are both positive and negative (e.g. Olsson et al., 2009; Olsson & Salo, 2011; Linaza et al., 2012). When it comes to on-trip content delivery a number of issues have to be addressed. At the same time, improvement in design and development has to reflect the specified marketing

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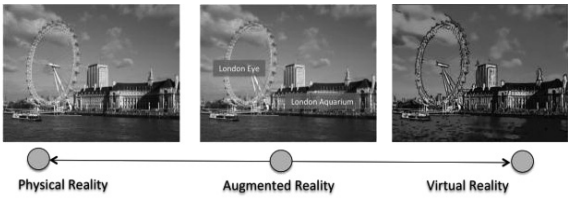
objectives of service providers. These can be achieved only if AR information systems are engineered with the target audience and target experience in mind. This is where a deeper understanding and effective use of this novel technology becomes key. Therefore, the main objectives of this study are:

- To conceptualize augmented tourism experiences. To achieve this objective, a definition of augmented tourism experiences is proposed.
- To explore the variety of augmented tourism experiences. This is based on a critical synthesis and analysis of the available past and recent literature.
- To propose a framework for engineering augmented tourism experiences. To this end, a conceptual framework is proposed, capturing the determinants that have the most significant effect on augmented tourism experiences.

2 Augmented Reality

Augmented Reality enhances or augments the surroundings of its user in real-time with virtual information that supplements and co-exists with the real world (Milgram et al., 1994; Azuma et al., 2001). Enhancement of the physical environment through AR can relate to any human sense (Höllerer & Feiner, 2004), including sight (visual), hearing (audio), touch (haptic AR), smell (olfactory AR) and taste (gustatory AR). The main focus of this paper is on visual augmentation of the physical surroundings through any type of visual display (e.g. smartphone, tablet, PC monitor, glass displays). Despite the availability of audio and haptic augmentation, visual displays have a pivotal role in supporting the spatial on-trip activities of tourists (Bornträger et al., 2003). The evolution and development of visual AR is closely related to the history and development of virtual reality (VR), though there is a distinct difference between the two (Milgram et al., 1994), as illustrated in the Reality-Virtuality continuum (Figure 1). Unlike the completely computer-generated world of VR and the unchanged real environment, in AR systems "a virtual world supplements the real world with additional information" (Feiner et al., 1997, p.74).

Fig. 1. The Reality-Virtuality continuum (After: Milgram et al., 1994)



Augmentation of the human vision with digital information started quite recently, with the first documented attempt in the late 1960s (van Krevelen & Poelman, 2009). When mobile outdoor AR systems became available in 1997 (Feiner et al., 1997), their widespread use and adoption was restricted mainly because they required heavy, obtrusive and unfashionable equipment to work (van Krevelen & Poelman, 2010). Throughout the history of the AR domain, significant attention was directed towards development of better computational platforms, displays, registration and tracking methods, input techniques and, last but not least, network data transmission protocols.

In this context, Virtual Reality (VR) and AR technologies gained from similar technological progress and are often discussed and reviewed under the same umbrella when it comes to the benefits for tourism (Guttentag, 2010). The presented definition for AR, however, underlines the substantial differences and potential of these two technologies for tourism. In this paper, the main accent is firmly placed on AR and its potential to enhance the tourist experience.

3 Augmented Tourism Experiences

3.1 Understanding technology-enhanced tourist experiences

The traditional elements of differentiating marketing products and services to consumers such as price, product and quality are no longer enough and customers now look for meanings and added value in the form of specific experiences tied to the products/services on offer (Pine & Gilmore, 1998; O'Sullivan & Spangler, 1998). Pine & Gilmore (1998) introduced the concept of experience economy as the fourth stage of the evolution/shift of economic offerings. This shift towards experience prompted the emergence of what Binkhorst & Den Dekker (2009) called 'a new hype' in marketing and economic research. The aspects and determinants of tourist experiences gained recently significant prominence in tourism literature and a number of studies have examined the influence of ICTs on tourism experiences (Volo, 2009; Tussyadiah & Fesenmaier, 2009). More recently, Neuhofer & Buhalis (2012) introduced the notion of technology-enabled enhanced tourist experiences. The authors discuss the need for conceptualization of technology-enhanced tourist experiences and introduced a holistic framework (Neuhofer & Buhalis, 2012). The study presented in this paper draws from such previous research to examine the specific role of Augmented Reality technologies and their impact on the tourist experience.

3.2 Defining Augmented Tourism and Augmented Tourism Experiences

The real world is not a computer screen and while on a trip tourists have to struggle to find information that is "somewhere out there" in a wide and constantly expanding virtual space. Augmented Tourism (AT) relates to a group of displays and technologies that have the ability to overlay in real-time virtual information in tourism-related surroundings. Moving through such information-rich environments has already been described in several conceptual and innovative visionary works. One of the first, building upon the works of Egenhofer (1999) and Weiser (1991), is the research exploring the idea of Augmented Spaces (Manovich, 2006) as physical space overlaid with layers of virtual information. It is important to note that Augmented Tourism is a visualization paradigm that is significantly different from Virtual Reality (VR) Tourism. Augmented Tourism strives for improving the usability and usefulness of the physical world in real-time through enhancing the (visual) perception of tourists about their environment.

Recently the resulting experience of a product or service became a popular subject within a number of areas. Customer experience is a term that has been used for a long time in management and marketing literature in a relatively loose manner (Frow & Payne, 2007). Yet, there is still no clear definition or understanding of how we can

achieve enhanced customer experiences (Palmer, 2010). A similar trend is noticed in literature that discusses virtual reality tourism experiences (Guttentag, 2010). Building on definitions within Psychology (Carlson, 1997), Product Design (Hekkert & Schifferstein, 2008), Human-Computer Interaction (Hassenzahl & Tractinsky, 2006), Tourism Marketing and Management (Frow & Payne, 2007), Augmented Reality (Azuma et al., 2001) and eTourism (Volo, 2009; Neuhofer & Buhalis, 2012) we define an augmented tourism experience as: A complex construct which involves the emotions, feelings, knowledge and skills resulting from the perception, processing and interaction with virtual information that is merged with the real physical world surrounding the tourist. An augmented tourism experience occurs when a tourist uses an AR display in order to view virtual information within their immediate field of view. In contrast, in VR tourism the experience is characterized by the degree of immersion and presence of a "tourist" into a completely synthetic computer-generated world (Guttentag, 2010). Augmented tourism experiences are not isolated but, instead, fused seamlessly with the real world. Therefore, unlike VR that is used mainly pre- and post-travel, augmented tourism experiences complement the on-trip experiences of tourists. Therefore, they unravel in situ and in real time. Due to lack of control over a dynamic and diverse environment where these experiences take place, the aspects and factors that must be considered when it comes to augmenting the on-trip tourist experience are fundamentally different from those determining a VR environment. Hence, an authentic augmented tourism experience requires particular attention to achieving a high degree of fusion between virtual and physical objects.

3.3 Characteristics of augmented tourism experiences

While user experience is an important notion within the Human-Computer Interaction (HCI) domain, the expected and actual experiences from using AR in the context of tourism is still an under-researched topic. Most of the recent studies and evaluations concentrate on usability aspects, particularly focusing on perceptual and cognitive issues (Swan II & Gabbard, 2005) or increasing task-specific efficiency of using AR in, for instance, military (Livingston et al., 2011) scenarios. However there are also several recent publications, documenting the actual experiences of early smartphone AR adopters (Olsson et al., 2009) and expected AR user experiences (Olsson & Salo, 2011). Olsson and Väänänen-Vainio-Mattila (2011) conducted empirical studies to uncover the characteristics of expected user experiences with AR content, interaction and functionality. Amongst others these include captivation, motivation, engagement and novelty. In this study, we extend this typology based on empirical studies and tourism-specific AR literature. As a result, several dimensions, such as safety, were added. A short synthesis of the typology is presented in Table 1. In addition, the table describes the current or potential scenarios characteristic for each augmented tourism experience.

Table 1. Characteristics of Augmented Tourism Experiences, their potential use within the tourism domain and examples of already developed AR systems.

Experience	Use-case Scenario	Source
Awareness Awareness of the surroundings	An AR system overlays a layer of rich digital content on top of museum artefacts	Abawi et al., 2004
Efficiency The system saves time and (cognitive/physical) effort	A tourist is able to see a virtual arrow pointing to POIs	Liarokapis et al., 2006
Empowerment Enabling novel activities and access to new services	A tourist is able to see hidden objects, especially where buildings limit visibility towards interesting attractions	Furmanski et al., 2002
Engagement Increased attention to specific objects or environmental features	A tourist is able to see a virtual reconstruction of the ancient temple in Olympia, Greece	Vlahakis et al., 2001
Fun Feeling of being amused	A visitor is able to see herself/himself in futuristic/historic outfits overlaid on their body	Disney (2012)
Liveliness The service and environment feeling vivid and dynamic	A tourist is able to see how virtual characters come to life to tell stories about the artefacts in a museum	MindSpace Sollutions, 2012
Meaningfulness AR content which is personally meaningful, relevant and reliable	An AR system overlays dynamic, updated and timely information on a paper-based map	Reitmayr et al., 2005
Motivation Being more motivated to participate or to do tedious tasks	A user of an AR system is able to view a complex dance performance from all angles, learn movements and participate	Cheok et al., 2002
Novelty Experiencing the environment in a new and unfamiliar way	An AR system revives extinct animal species or show the future fauna and flora of the Earth	Futuroscope, 2012
Playfulness and entertainment Feelings of joy and playfulness	Animated characters re-enact the historic life at the Gyeongbokgung in Korea	Kim & Park, 2011
Safety The system increases the feelings of safety and control	A driver is able to swiftly detect moving/static targets on the road that may compromise the safety of the car	Narzt et al., 2006
Surprise Positive surprises and wonder due to surpassed expectations	An anthropomorphic (human-like) AR virtual character interacts with the tourist and provides information about POIs	Schmeil & Broll, 2007
Tangibility Feelings of coherence, which lead to senses of presence and unity with the surroundings	A tourist is able to see a 3D miniature overview model of their surroundings displayed immediately in their field of view	Bell et al., 2002

After: Olsson & Väänänen-Vainio-Mattila, 2011.

Recently, a lot of attention within industry and academia was directed towards increasing the awareness of consumers for products and services. This is evident in the proliferation of smartphone AR browsers (Madden, 2011) that deliver information about different points of interest in urban (Linaza et al., 2012) or rural (Luley et al., 2011) tourism scenarios. However, as our typology reveals, the on-trip tourist experience can be enhanced in many additional ways and result in novel, memorable, exciting and overall extraordinary experiences. Each aspect of such enhanced tourist experiences is tied to a specific situation (use-case scenario) and can be manipulated through a number of critical design decisions. The next sections discuss the key factors that influence the resulting augmented tourist experience.

4 Engineering Augmented Tourism Experiences

The presented augmented tourism experiences typology (Table 1) reflects the potential of AR to enhance the on-trip experiences of tourists in a positive way. However, as a number of empirical studies suggest, the introduction of AR in tourism-related settings does not necessarily lead to positive experiences. There is evidence in fact to suggest that various AR displays and content can lead to confusion, dissatisfaction, physical fatigue and disappointment (Herbst et al., 2009; Olsson et al., 2009; Linaza et al., 2012).

When engineering a desired augmented tourism experience, two equally important categories of determinants are crucial: (i) the delivered content that is used to augment the surrounding environment and (ii) the surrounding context. Figure 2 describes these two major categories. In each category, a number of factors need to be taken into account when introducing AR to tourism settings. In this section we present a framework that could be used for engineering the desired positive AT experience. All of the factors in the framework are inter-related and need to be taken into account in order to create the desired positive augmented tourism experience.

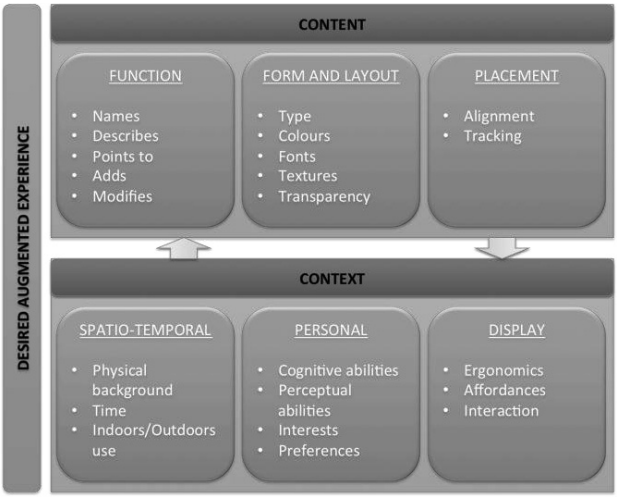


Fig 2. Framework for engineering augmented tourist experiences

4.1 Content

Function - The different properties of presentation of information are an important determinant of an AR experience. AR content can have several functions: it names, describes, directs to, adds to, and modifies. The names, describes and directs to functions can be performed by traditional paper-based or mobile guidebooks (e.g. Bornträger et al., 2003). AR, however, decreases the time and cognitive workload for the tourist to look up this information, since it is attached to a specific context (Kjeldskov, 2003). What distinguishes AR from other information sources are the adds to (e.g. Piekarski & Thomas, 2003) and modifies (e.g. Vlahakis et al., 2001) functions of delivered content. The selected function however has to reflect the tasks of the user, since it could otherwise lead to confusion and feeling of dissatisfaction with content.

Form and Layout - According to van Krevelen & Poelman (2010, p.10) "commercial success of AR systems will depend heavily on the available type of content". Virtual information delivered through an AR display can be in the form of individual pieces of text, pictures, images, animations, 3D models, animated 3D models or combinations of these elements. Apart from the alignment and seamless fusion of virtual and physical objects, one concern that is specific for the domain of tourism is the quality of the (computer-generated) virtual content displayed on a visual display. Lack of accuracy and currency, as well as realism (shading, shadows, textures) may ultimately lead to negative reactions. Furthermore, when it comes to smartphone devices, an additional concern is content personalization. Choosing the right content and adapting it to the specific context of use (see below) often requires a multi-disciplinary effort, special expertise and skills.

Placement - Seamless fusion means that the user of an AR system perceives virtual content as part of the real world (Azuma et al., 2001) in a way that blurs the "boundary between what is real and what is not" (Larsson et al., 2010, p.143). Although it may seem simple, this requirement is one of the most challenging aspects for AR (Bell et al., 2002; Kjeldskov, 2003; Madden, 2011). Various tracking methods have been developed and are primarily concerned with aligning the virtual content with the real world (Azuma et al., 2001). In general, there are three main tracking approaches: marker-based, marker-less and hybrid. While discussion of each is out of the scope of this paper, selecting a tracking approach has implications for the resulting user experience and needs to be considered carefully. More detailed descriptions can be found elsewhere (e.g. Henrysson & Ollila, 2004; Madden, 2011).

4.2 Context

While for many types of interactive tourism systems context-awareness and adaptation are still optional, AR depends on being adaptive to the physical context in which it is used (Kjeldskov, 2003). Context-aware AR (CA AR) systems deliver information that is optimally placed in the context in which it is used.

Spatio-temporal context - At the very least, obtaining spatial information (location and orientation) is a key requirement for mobile AR systems. Currently, location-based adaptation and personalization are the most widely utilized adaptation types. Similar to other types of mobile tourism information systems (Buhalis & Law, 2008),

personalization is also very important for AR systems, especially when it comes to accessible tourism. Personalized AR systems can provide information according to the special needs of tourists. Ideally, a CA AR system would adapt the information that is delivered to the user not only to his/her location, orientation and task (Bell et al., 2001), but also to many additional contextual factors. Amongst many others these include field-of-view (Kjeldskov, 2003), proximity to objects and subjects (Kjeldskov, 2003) and whether the user focuses attention on them or not (Ajanki et al., 2010). Lightning conditions and shadows (Papagiannakis et al., 2005) plus textures of the surroundings and their colours are also important (Mendez & Schmalstieg, 2007). However, both natural and artificial environment settings are dynamic and might change abruptly. There is still an on-going debate on what is the exact range and nature of the contextual parameters an AR system has to adapt to. This is why their selection and combination is often determined on an ad hoc basis.

Personal aspects - When designing AR experiences, it is important to take into account the perceptual (the ability to recognize and interpret visual stimuli) and cognitive (the ability to reason about those stimuli) abilities of humans (Furmanski et al., 2002). As Bell et al. (2002) note, if the tourist is mobile in an unfamiliar environment, the virtual overlay has to "enrich and explain, rather than clutter and confuse, the user's physical surroundings" (Bell et al., 2002, p. 213). This means that, irrespective of application and display, it is fundamentally important to deliver clear representation of meaningful information, in a way that enhances perceptual learning and prevents cognitive overload. This is probably the reason as to why user-based empirical studies within the AR domain have predominantly concentrated on perceptual issues (Swan II & Gabbard, 2005; Dünser et al., 2008). Significant challenges are connected with displaying occluded structures and objects (Furmanski et al., 2002) but also with impaired sight due to changing environmental conditions, such as bright sunlight (Thomas et al., 2000). Cognitive issues include the ability of users to make sense of the presented content. A number of user studies reveal that content may be unclear and ambiguous (Thomas et al., 2000; Schmeil & Broll, 2006; Linaza et al., 2012). Such results emphasize the need for simplicity. Addressing this problem within is not trivial since its solution would depend on the characteristics of the target user group. Within the tourism domain this target group is extremely variable in terms of age, experience, skills and knowledge, interests, preferences and education.

Display - The display, where virtual content is visualized and presented to the user, is probably the most important part of any AR system and an important constituent of an AR experience (Azuma et al., 2001). There are a number of displays that can be used to deliver an AR experience and their general characteristics have been amply described in literature (Azuma et al., 2001; Bimber & Raskar, 2005; van Krevelen & Poelman). For instance, significant challenges are posed especially for AR public displays where the "diversity of behaviours…[makes it] very difficult to find profiles and patterns of usability" (Alzua-Sorzabal et al., 2007). For instance, the height of an AR telescope, the position of interaction buttons or limited field-of-view might be a problem (Alzua-Sorzabal et al., 2007). Head-worn displays have a wider field-of-view but pose challenges with respects to portability due to large and cumbersome displays and fragile connections between the various components of the system (van Krevelen

& Poelman, 2010). Modern handheld displays, such as the smartphone or tablet, solve this problem. However, the user has to hold the device upright with an extended arm for prolonged periods of time, which can be very awkward. A surface-based augmentation is suitable to accommodate multi-user collaborative experiences and does not require tourists wearing any special equipment (Bimber & Raskar, 2005). This makes surface-based AR systems especially suitable for museums, special indoor events and exhibitions, but also in hotels or airports.

5 Conclusions

This paper contributes to eTourism literature in three ways. First, it introduces the notion of augmented tourism experiences, distinguishing in this manner the medium from VR tourist experiences which are not only different by nature, but unravel in substantially different circumstances. Second, several streams of state of the art research were integrated to conceptualize the key characteristics of augmented tourism experience. Third, we develop a framework that examines the key determinants of positive (desired) augmented tourism experiences. As suggested in the framework, the quality of the resultant experience with AR systems during on-trip activities of tourists depends on the provided content. Additionally, for AR technology to be useful, attractive, engaging and proactive for visitors to unfamiliar environments, the provided content needs to fit within the wider spatio-temporal, personal and technical context where the system is used. The fit between context and content will ultimately determine the value that AR systems bring to the holistic tourist experience.

The developed framework has both practical and academic implications. From a practical point of view, it serves as a tangible guide for designers and developers of augmented tourism experiences, outlining the key factors that need to be considered. The field of AR is constantly growing in many directions and it is naturally difficult to make accurate long-term predictions for its future direction. However, looking at current academic literature, one key observation that can be made is that development is still driven from areas outside the tourism domain. Therefore, it is suggested that further research within tourism should be carried out. In this sense, the developed framework can serve as a starting point for identifying additional gaps within academic literature. Although outside the scope of this study, further empirical research could assess and enhance the effectiveness of the proposed framework. Field-based experiments and observations could also validate the link between the identified factors and their specific influence on the overall augmented tourism experiences. Finally it should be noted that this study is part of a bigger research project that uses the proposed framework to engineer aspects of AT experiences, such as awareness, comfort and efficiency. The results from an on-going, mobile, field-based trial with smartphone AR browsers will be eventually used to validate the proposed framework.

6 References

Abawi, D., Los Arcos, J., Haller, M., Hartmann, W., Huhtala, K. & Träskbäck, M. (2004). A mixed reality museum guide: the challenges and its realization. In Proceedings of the 10th Conference on Virtual Systems and Multimedia (VSMM), Gifu, Japan.

Ajanki, A., Billinghurst, M., Gamper, H., Järvenpaa, T., Kandemir, M., Kaski, S., Koskela, M., Kurimo, M., Laaksonen, J., Puolamaki, K., Ruokolainen, T. & Tossavainen, T. (2010). An augmented reality interface to contextual information. Virtual Reality 15(2-3): 1-13.

Alzua-Sorzabal, A., Linaza, M. & Abad, M. (2007). An experimental usability study for Augmented Reality technologies in the tourist sector. In M. Sigala, L. Mich & J. Murphy (Eds.) Information and Communication Technologies in Tourism. New York: Springer, pp. 231-242.

Azuma, R., Baillot, Y., Behringer, R., Feiner, S., Julier, S. and MacIntyre, B. (2001). Recent advances in Augmented Reality. IEEE Computer Graphics & Applications 21(6): 34-47.

Bell, B., Höllerer, T. & Feiner, S. (2002). An annotated situation-awareness aid for Augmented Reality. In Proceedings of the Symposium on User Interface Software & Technology (UIST). Paris, France, ACM Press, pp. 213-216.

Bimber, O. & Raskar, R. (2005). Spatial Augmented Reality: Merging Real and Virtual Worlds. Boston, MA: A.K.Peters.

Binkhorst, E. & Den Dekker, T. (2009) Agenda for co-creation tourism experience research. Journal of Hospitality Marketing & Management 18(2): 311-327.

Bornträger, C., Cheverst, K., Davies, N., Dix, A., Friday, A. & Seitz, J. (2003). Experiments with multi-modal interfaces in a context-aware city guide. In L. Chittaro (ed), Human-Computer Interaction with Mobile Devices and Services. New York: Springer-Verlag, pp. 116-130.

Buhalis, D. & Law, R. (2008). Progress in information technology and tourism management: 20 years on and 10 years after the Internet - the state of eTourism research. Tourism Management 29(4): 609-623.

Carlson, R. (1997). Experienced Cognition. Mahwah, NJ: Erlbaum.

Cheok, A., Weihua, W., Yang, X., Prince, S., Billinghurst, M. & Kato, H. (2002). Interactive theatre experience in embodied wearable mixed reality space. In Proceedings of the 1st International Symposium on Mixed and Augmented Reality. Darmstadt, Germany, pp. 59-317.

Disney, 2012. Disneyland Tomorrowland. Retrieved October 20, 2012 from http://disneyland.disney.go.com/disneyland/tomorrowland/.

Dünser, A., Grasset, R. & Billinghurst, M. (2008). A survey of evaluation techniques used in augmented reality studies. In Proceedings of SIGGRAPH Asia. Singapore, ACM Press.

Egenhofer, M. (1999). Spatial Information Appliances: a next generation of Geographic Information Systems. In Proceedings of the 1st Workshop on Geoinformatics, Campinas, Brazil, pp.1-4.

Feiner, S., MacIntyre, S., Höllerer, T. & Webster, A. (1997). A touring machine: prototyping 3D mobile augmented reality systems for exploring the urban environment. Personal and Ubiquitous Computing 1(4): 208-217.

Frow, P. & Payne, A. (2007). Towards the perfect customer experience. Journal of Brand Management 15(2): 89-101.

Furmanski, C., Azuma, R. & Daily, M. (2002). Augmented-reality visualizations guided by cognition: Perceptual heuristics for combining visible and obscured information. In Proceedings of the 1st IEEE International Symposium on Mixed and Augmented Reality (ISMAR), IEEE Computer Society, pp. 215-225.

Futuroscope, 2012. Retrieved June 17, 2012 from http://en.futuroscope.com/.

Guttentag, D. (2010). Virtual reality: applications and implication for tourism. Tourism Management 31(5): 637-651.

Hassenzahl, M. & Tractinsky, N. (2006). User experience – a research agenda. Information Technology 25(2): 91-97.

Hekkert, P. & Schifferstein, H. (2008). Introducing product experience. In H. Schifferstein & Hekkert, P. (Eds), Product Experience, San Diego: Elsevier Ltd.

Henrysson, A. & Ollila, M. (2004). UMAR - Ubiquitous mobile Augmented Reality. In Proceedings of the 3rd Conference on Mobile and Ubiquitous Multimedia (MUM), Colledge Park, MD: ACM Press, pp. 41-45.

Herbst, I., Braun, A.-K., McCall, R. & Broll, W. (2008). TimeWarp: interactive time travel with mobile mixed reality game. In Proceedings of the 10th International Conference on Human-Computer Interaction with Mobile devices and services. Amsterdam, the Netherlands, ACM Press, pp. 235-244.

Höllerer, T. & Feiner, S. (2004). Mobile Augmented Reality. In H. Karimi & A. Hammad (Eds.), Telegeoinformatics: Location-based Computing and Services. Boca Raton, FL: CRC Press.

Kandampully, J., Mok, C. & Sparks, B., (2001). Service Quality Management in Hospitality, Tourism and Leisure. Binghamton, NY: Hawthorn Hospitality Press.

Kim, J.-B. & Park, C. (2011). Development of mobile AR tour application for the National Palace Museum of Korea. In R. Schumaker (Ed.), Virtual and Mixed Reality, Part I, HCII 2011. Springer-Verlag, pp. 55-60.

Kjeldskov, J. (2003). Lessons from being there: interface design for mobile augmented reality. In L. Qvortrup (ed.), Virtual Applications: Applications With Virtual Inhabited 3D Worlds. Berlin: Springer-Verlag.

Larsson, P., Väljamäe, A., Västfjäll, D., Tajadura-jiménez, A. & Kleiner, M. (2010). Auditory-induced presence in mixed reality environments and related technology. In E. Dubois, P. Gray & L. Nigay (Eds.), The Engineering of Mixed Reality Systems, Human-Computer Interaction Series. London: Springer-Verlag.

Liarokapis, F., Brujic-Okretic, V. & Papakonstantinou, S. (2006). Exploring urban environments using virtual and augmented reality. Journal of Virtual Reality and Broadcasting 3(5): 55-76.

Linaza, M., Marimon, D., Carrasco, P., Alvarez, C., Montesa, J., Aguilar, J. & Diez, G. (2012). Evaluation of mobile augmented reality applications for tourist destinations. In M. Fuchs, F. Ricci & L. Cantoni (Eds.), Information and Communication Technologies in Tourism. Berlin: Springer, pp. 260-271.

Livingston, M. A., Ai, Z., Karsch, K. & Gibson, G. (2011). User interface design for military AR applications. Virtual Reality 15(2-3): 175-184.

Luley, P., Perko, R., Weinzerl, J., Paletta, L. & Almer, A. (2011). Mobile Augmented Reality for tourists – MARFT. In G. Gartner & F. Ortag (Eds.), Lecture Notes in Geoinformation and Cartography, Berlin: Springer, pp. 21-36.

Madden, L. (2011). Professional Augmented Reality Browsers for Smartphones. Chichester, UK: John Wiley and Sons Ltd.

Manovich, L. (2006). The poetics of augmented space. Visual Communication 5(2): 219-240.

Mendez, E. & Schmalstieg, D. (2007). Adaptive Augmented Reality using context markup and style maps. In Proceedings of the 6th International Symposium on Mixed and Augmented Reality (ISMAR), Washington, USA, ACM Press.

Milgram, P., Takemura, H., Utsumi, A. & Kishino, F. (1994). Augmented Reality: a call for displays on the Reality-Virtuality continuum. In SPIE, Telemanipulator and Telepresence Technologies, 2351, pp. 282-292.

MindSpace Solutions (2012). Digital Binocular Station. Retrieved June 16, 2012 from http://digitalbinocularstation.com/

Narzt, W., Pombeger, G., Ferscha, A., Kolb, D., Muller, R., Wieghardt, J. (2006). Augmented reality navigation systems. Universal Access in the Information Society 4(3): 177-187.

Neuhofer, B. & Buhalis, D. (2012). Understanding and managing technology-enabled enhanced tourist experiences. In Proceedings of the 2nd Conference on Hospitality and Tourism Marketing & Management, Corfu, Greece.

O'Sullivan, E. & Spangler, K. (1998). Experience marketing: strategies for the new millennium. State College, PA: Venture Publishing.

Olsson, T . & Väänänen-Vainio-Mattila, K. (2011). Expected user experience of mobile Augmented Reality services. In Proceedings of the 13th Conference on Human-Computer Interaction with Mobile Devices and Services, MobileHCI 2011. Stockholm, Sweden, ACM Press.

Olsson, T. & Salo, M. (2011). Online user survey on current mobile augmented reality applications. In Proceedings of the 10th International Symposium on Mixed and Augmented Reality (ISMAR). Basel, Switzerland, ACM Press.

Olsson, T., Ihamäki, P., Lagerstam, E., Ventä-Olkkonen, L. & Väänänen-Vainio-Mattila, K. (2009). User expectations for mobile mixed reality services: an initial user study. In Proceedings from the European Conference on Cognitive Ergonomics: Designing beyond the Product. Helsinki, Finland, ACM Press.

Palmer, A. (2010). Customer experience management: a critical review of an emerging idea. Journal of Service Marketing 24(3): 196-208.

Papagiannakis, G., Schertenleib, S., O'Kennedy, B., Arevalo-Poizat, M., Magnenat-Thalmann, N., Stoddart, A. & Thalmann, D. (2005). Mixing virtual and real scenes in the site of ancient Pompeii. Computer Animation and Virtual Worlds 16(1): 11-24.

Piekarski, W. & Thomas, B. (2003). Augmented Reality user interface and techniques for outdoor modelling. In Proceedings of the Symposium on Interactive 3D graphics (I3D). Monterey, CA, ACM Press, pp. 225-226.

Pine, J. & Gilmore, J. (1999). The Experience Economy: Work is a Theatre and every Business a Stage. Cambridge: Harvard Business School.

Reitmayr, G., Eade, E. & Drummond, T. (2005). Localisation and interaction for augmented maps. In Proceedings of the 4th International Symposium on Mixed and Augmented Reality (ISMAR). Vienna, Austria, IEEE Computer Society.

Schmeil, A. & Broll, W. (2006). MARA: An Augmented personal assistant and companion. In Proceedings of SIGGRAPH 2006. Boston, USA, ACM Press.

Swan II, J. & Gabbard, J. (2005). A survey of user-based experimentation in Augmented Reality. In Proceedings of the 1st International Conference on Virtual Reality (VR '05). Las Vegas, NE, Lawrence Erlbaum Associates.

Thomas, B., Close, B., Donoghue, J., Squires, J., De Bondi, P., Morris, M. & Piekarski, W. (2000). ARQuake: an outdoor/indoor Augmented Reality first person application. In Proceedings of the 4th International Symposium on Wearable Computers (ISWC). Linz, Austria, IEEE Computer Society, pp. 139-146.

Tussyadiah, I. & Fesenmaier, D. (2009). Mediating the tourist experiences: access to places via shared videos. Annals of Tourism Research 36(1): 24-40.

Tussyadiah, I. & Zach, F. (2011). The role of geo-based technology in place experiences. Annals of Tourism Research 39(2): 780-800.

van Krevelen, D. & Poelman, R. (2010). A survey of augmented reality technologies, applications and limitations. International Journal of Virtual Reality 9(2): 1-20.

Vlahakis, V., Karigiannis, J., Tsotros, M., Gounaris, M., Almeida, L., Stricker, D., Gleue, T., Christou, I., Carlucci, R. & Ioannidis, N. (2001). ARCHEOGUIDE: First results of an Augmented Reality, mobile computing system in cultural heritage sites. In Proceedings of the Conference on Virtual reality, Archaeology, and Cultural heritage (VAST). Glyfada, Greece, ACM Press, pp. 131-140.

Volo, S. (2009). Conceptualizing experience: a tourist based approach. Journal of Hospitality Marketing and Management 18(2-3): 111–126.

Weiser, M. (1991). The computer in the 21st century. Scientific American 265(3): 94-110.