حوليات آداب عين شمس المجلد 49 (عدد يناير – مارس 2021)
http://www.aafu.journals.ekb.eg
(دورية علمية محكمة)
كلية الآداب
جامعة عين شمس

Augmented Reality in Tourist Guidance

Hazem Mohamed Farrag*

Lecturer of Tourist Guidance, Tourist Guidance Department, Faculty of Arts - Ain Shams University
hazem_farrag@art.asu.edu.eg

Abstract

Augmented reality (AR) is an interactive experience of a real-world environment where the objects that reside in the real world are augmented by computer-generated perceptual information. Augmented reality has a great potential utilization in wide range of tourism fields and one of the upcoming fields is tourist guidance.

This paper presents an overview of the basic aspects and the benefits of augmented reality potential utilization in the field of tourist guidance and improvement of guide's performance. However, possibilities of augmented reality technology in tourist guidance are great and providing new ways of guidance. Augmented reality in tourist guidance is still new and unsettled.

Keywords: Augmented Reality (AR) - 3D Model - Tourism - Tourist Guidance - Heritage Site – Museum - Navigation - App - AR Gaming.

1. Introduction

The tourism industry is always trying to track the new technologies, as the new generation of travelers are active smartphone users that use smart devices to access social platforms, play games and to be in connection with friends and relatives. New technology improvements, such as "virtual reality" (VR) and "augmented reality" (AR), can improve the tourism industry and convey new opportunities[1]. Recently, different areas of business especially tourism have already implemented augmented reality technology[2].

Augmented Reality (AR) is an interactive experience and developing technology that superimposes computer-generated enhanced images or virtual objects on a live real world environment in real time, thus providing a composite view[3]. In other words, AR is the overlay of computerized information that is projected into the view of the user through smart devices such as smartphones, tablets and AR glasses[4] by matching a camera image to images in a database on a server that have geotags[5] in the area of the user's location[6] (Figure 1).

Figure 1: Tourist information as shown by an AR app; https://medium.com/iotforall/will-ar-vr-replace-travel-tourism-662bf9eeb61b - visited on 01/03/2019.

Augmented Reality (AR) is different from Virtual Reality (VR); in VR tourist is experiencing a very artificial computer-generated virtual environment[7], VR technology uses a total computer-generated environment to immerse the user into a virtual world completely[8]. In contrast, AR provides users with additional digital information integrated into existing physical environments. Moreover, AR technology focuses on the physical environment and does not transport users to an artificial world, and does not requires expensive hardware and equipment as well, so that many tourists prefer AR to VR[9].

Now the technologies that make AR possible are much more powerful than ever before and compact enough to deliver AR experiences to tourist sites through smart devices that makes AR more sociable, communicative and apprehensive, combining art, culture, architecture and design with projections, surround sound and special effects[10].

The main objective of this study was to explore the benefits and the ways of implementation of AR in the tourist guidance and provide up-to-date information about AR applications that can be adopted in tourist guidance.

2. AR applications in Tourist Guidance:

2.1 AR in Heritage Sites:

AR, by range of options, could reforming the common tourist guidance technique by providing tourists with further digital enhanced information about any subject, making difficult information easier to understand, and making the tour more attractive and engaging. A new study highlights that AR has a great potential to enhance tourists' experiences, to change the location and timing of tourist guidance and to introduce new and further techniques and methods[11].

2.1.1 Virtual Reconstruction: AR focuses on simplicity and ease of providing explanation experience, so that tourists can receive knowledge and skills with 3D simulations generated by computers and other electronic devices more than traditional ways. AR can explain the architectural design or structure of a pyramid, a temple or a tomb (Figure 2).

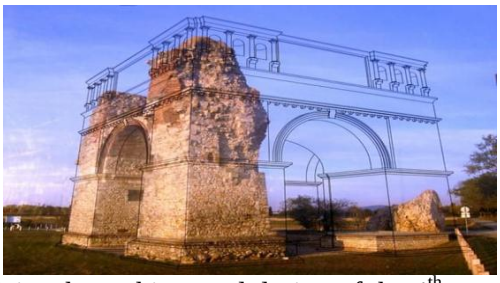

Figure 2: AR explains the architectural design of the 4th century triumphal arch Heidentor in Carnuntum near Vienna in Austria.
http://www.romeacrosseurope.com/wp-content/uploads/2015/10/Heidentor_Carnuntum.jpg- visited on 09/04/2019.

For example, in the Karnak Temple Complex[12], tourists can receive enhanced and additional three-dimensional information, see the original architectural design of the 8th pylon, scan certain elements of the pylon and see animated components about the part that needs translation. Moreover, AR apps can overlay information about the Ancient Egyptian gods and goddesses[13] and the figures as users browse the wall scenes with the see-through view from the camera on their smart phones.

2.1.2 Improving Information and Understanding:

Guides know that the guidance process should be all about inspiration and interaction. Their goal is to get the tourists interested in a subject or topic. Tourists should not be mere listeners and passive observers, some tourists especially teenagers need practice and hands-on experience.

The ability to connect reality and digital content has been improving, opening more options for tour guides and tourists[14].

For Example, AR can improve the extent and quality of information in Giza Plateau[15] by making explanation environment more educational, productive, and contextual. In order to enhance the quality of explanation by producing and delivering rich, constructive, and gainful content. AR can make Giza Plateau more enjoyable and interactive than ever before by interaction with computer generated display, sound, text and 3D effects (Figure 3).

Figure 3: A traveler checks for relevant tourist information of Milan Cathedral using AR app in his handheld device.
https://cmolds.com/blog/wp-content/uploads/2019/01/title.jpg - visited on 05/03/2019.

2.1.3 Simplifying Abstract Concepts: AR has the potential to have tourists more engaged and motivated in discovering history and heritage sites. AR technology has an ability to explain abstract and difficult concepts by rendering objects that are hard to imagine and turn them into 3D models, thus making it easier to grasp the abstract and difficult content. This is especially good for visual tourists and practically anyone to translate theoretical material into a real concept[16].

Simply, by wearing AR glasses, tourists receive enhanced and additional three-dimensional information, see what the Great Pyramid at Giza[17] consists of and how it look from inside, scan certain elements of a pyramid and see animated components about the part that needs translation, while an audio instruction talks to them about each word and scene through headphones integrated inside the AR glasses (Figure 4).

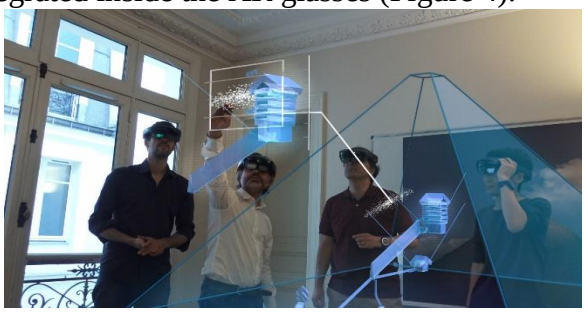

Figure 4: Viewing 3D computer-generated models by AR glasses.
https://thenypost.files.wordpress.com/2017/12/171214-pyramid-scan-robot-06.jpg?quality=90&strip=all&strip=all - visited on 20/04/2019.

2.1.4 Navigation: AR navigation applications in heritage sites are attractive, stimulating, and exciting for tourists and provide effective and efficient supports for them by providing information at the right time and right place and offering rich content with computer-generated 3D imagery. Some theme parks or vast heritage sites only have traditional maps, stands and direction signs.

As an alternative, by using AR techniques that are more interesting than existing traditional explanation methods, tourists can utilize AR navigation applications to see informational displays of a location, landscape, and information provided by previous visitors or even cartoon or animal characters to play with[18]. For example, during a tour in Downtown Cairo[19], tourists can use AR navigation applications to see informational displays of historical events, architectural designs and famous landmarks. Egyptian temples in Lower Nubia.

2.1.5 Destination Marketing: another aspect is improving destination marketing; one of the types of advertising in the tourism industry is publishing destinations or museums paper brochures and catalogs. In this regard, a marker-based augmented reality app can provide prices and valuable information by turning every items of catalogues into 3D visualized animated models and help make the final decision faster.

For example, tourists to Egypt can efficiently use such catalogues on flights to Egyptian destinations or inside Egyptian Airports to help them planning their trips in Egypt.

2.1.6 Bringing History Back to Life: AR has been applied to remembering the historical events; AR provides reconstructions of ancient ruins, and ancient time image rendering. The visitors will be able to travel back in time to see how the heritage site would have looked during the past times by recreating the temple site and viewing 3D models of the construction, how it looked, and who the person was, even though it does not exist anymore or just remains some ruins (Figure 5).

Figure 5: AR brings history back to life so traveler could look at a place through the lens of the past.
https://images.thestar.com/content/dam/thestar/life/2015/04/07/new-apps-help-you-interact-with-history-as-you-walk/pivot1jpg.jpg - visited on 07/05/2019.

For examples, AR can be used as an interactive tool in Al-Muʿiz Street or Royal palaces of Mohamed Ali Family by showing visitors the ancient images of the sites or the palaces and informing them of historical episodes of the places and seeing the evolution of landmarks in time perspective. AR can show screenshots of the ancient movies that had been filmed in Al-Muʿiz Street or the Royal palaces (Figure 5).

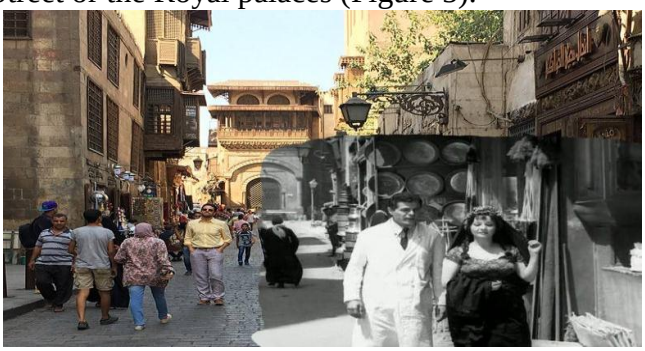

Figure 6: AR brings history back to life so traveler could look at a place through the lens of the past. An Augmented ancient photo for Al-Muʿiz Street from Naguib Mahfouz famous movie *Zouqâq al-Midaqq* (1963).
http://formisanowilson.com/wp-content/uploads/2016/04/heritage_app1.jpg - visited on 22/03/2019.

2.2 AR in Museums:

Museum is a major field where AR can open new opportunities. Unfortunately, during the last decade, museums all over the world witnessed a noticeable decrease in visitors. AR is a very efficient technology to reshape and enhance the visitor experience; museum visitors can strengthen their motivation for knowledge and enhance their informative realism-based practices with new augmented reality apps[20].

2.2.1 3D Virtual Tour Guide: visitors of museums could access AR apps via smart devices and discover historical content related to objects in the form of 3D digital media, videos and images. AR simply provide instant and relevant enriched information about what they see in order to increase their knowledge motivation and level of understanding[21]. Moreover, AR offers enhanced combination of diverse types of multimedia sources and visualizations, including 3D models, images, texts, videos, animations and sound along with the traditional methods to enhance the tourist environment[22] (Figure 7).

Figure 7: 3D virtual tour guide created by AR glasses at Kyoto's Kennin-ji, Zen temple in Japan.
https://hakuhodo-vrar.jp/kyoto2018/en/assets/img/photo8-l.png - visited on 07/05/2019.

A good example is The National Museum of Natural History in Washington, D.C. AR app (the Skin and Bones)[23]; the app allows visitors, mainly children, to see a full live digital representation - the shape of the body and skin color - of extinct animals such as dinosaurs based on their actual skeletons in the museum and encourage children to think scientifically. This AR app provide a better understanding of a dinosaur's appearance before and deliver rich, useful and visual information about any item, even now destroyed[24] (Figure 8).

Figure 8: Skin and Bones AR app developed by the National Museum of Natural History in Washington, D.C.,
https://www.inexhibit.com/wp-content/uploads/2015/01/skin-bones-app-natural-history-museum-smithsonian-01.jpg - visited on 17/04/2019.

In Egypt, alternative good Ancient Egyptian example is an AR app developed by the *Bibliotheca Alexandrina* called The Wall of Knowledge[25]. The main aim of the app is to increase public engagement with Egyptian art and heritage inside museums using smart devices. The app currently available at the Egyptian Museum in Cairo explains the ancient Egyptian Papyrus of Ani[26] in an enhanced experience. The papyrus can now be brought to life by simply pointing the smart Phone's camera at pre-designed poster, which include the papyrus basic information and read ancient texts through the phone. Users are able to extend this information by superimposing virtual text, images and 3D virtual objects over the poster (Figure 9).

Figure 9: The Wall of Knowledge AR app developed by the *Bibliotheca Alexandrina*, https://lh3.googleusercontent.com/yrLHg0trMPncWxikEVdtQNYTA7M_OyA15ID5rAU1gZrOi5gDcAPgmN1PWL_pwdYHzaM=h355 - visited on 07/05/2019.

At the Egyptian Museum in Cairo, the museum can create visual tour guides and exhibitions, bring non-existent objects to life, and educate visitors in a memorable way and fascinating people in general. A nice example is Museum Eye app; the Egyptian app based on augmented reality shows virtual characters and bring King Tutankhamen to life using augmented reality in the form of 3D virtual character accompanied by informative animations (Figure 10).

Figure 10: King Tutankhamen as a 3D virtual tour guide explains his tomb's treasure to the visitors at the Egyptian Museum in Cairo, https://wildfirecomms-images.co.uk/img/museum-eye-2-1520343057.jpg - visited on 03/05/2019.

2.2.2 Using AR Interaction Games: AR interaction games could potentially encourage and interest people to various tourism destinations especially the museums; a good example is Pokémon Go game[27], which enables users to capture 3D virtual characters in the real world. Pokémon Go, location-based game that uses augmented reality techniques has inspired many other businesses to utilize AR, including the museums, which are seen later as boring places for kids to explore.

For instance, The National Museum of Egyptian civilization in Cairo, can use apps, that display the items with additional AR objects and by finding or collecting number of virtual 3D hidden treasure or items, tourist will win awards (Figure 11). Augmented Reality in museums also

provides other beneficial potentials, such as the interactive billboards that include detailed maps of the museum[28].

Figure 11: AR Interaction Games, https://lh3.googleusercontent.com/VvyvIVipQZkPlK4q8zGxh7bBhUKbs5kpPfvWNM0oRgz1ul6st2_L8v3-IFsPt1jhZu4-Kw=s123 - visited on 09/04/2019.

2.3 AR in City Tours:

2.3.1 New Ways to Observe: Another aspect of the employment of AR in tourist guidance venues is city tours. By AR advanced navigation and exploration app, tourist can explore the city, locate all the points of interest, and find out about services, sights to see with more convenience, or point at the transportation object to get direction, route, next stop and places of interest.

For example, AR provides a new ways to observe Aswan city or Luxor city, makes it possible to discover information on a new level; with AR tourist can easily turn classic site wall maps in different locations into an interactive and quite enjoyable tour guide through data-visualization and can Show directions and location, description, opening hours and admission

fee (Figure 12).

Figure 12: AR provides new ways of navigation, https://jasoren.com/wp-content/uploads/2018/10/augmented-reality-applications-1.jpg - visited on 07/05/2019.

2.3.2 Solving Language Barriers: Furthermore, AR also solve the language barriers; AR apps such as Google Translate Augmented Reality App[29] help to avoid confusions of the local language, signs or instructions and checkup unknown words by instantly identifying and translating real-

time immediate information into tourist's native language[30]. This tool could be applied successfully in Upper Egypt where most of the signs or instruction are not translated or translated into one or two language.

2.4 AR in Guidebooks:

Guidebooks and brochures could be more exciting and extraordinary by adding AR technology. Tourists can turn the pages of a book, look at pictures, and read the texts in more interactive way by superimposing 3D virtual models onto books with AR technology. The 3D models can be amended, updated and seen from any perspective simply by moving the AR device or the guidebook (Figure 13).

Figure 13: AR app for guidebooks and brochures, https://jasoren.com/wp-content/uploads/2018/10/ar-app-screenshot.jpg - visited on 25/04/2019.

2.5 AR in Gaming:

AR have been widely used in games, AR gaming is the integration of game visual and audio content with the user's environment in real time. AR games increase the potential for collaboration, exciting and engaging among tourists, and enhance opportunities for reflection. AR gaming expands the playing field, taking advantage of the diversity of the real-world environment to keep the games interesting.

Since the adaptability and high customization of virtual information, many scenarios can be applied to the AR tourist games in Karnak Temples on east bank of Luxor or the Valley of the Kings[31] on the west bank of Luxor for examples; such as allows tourists to walk around and interact with the heritage site and experiencing different architectural elements. Moreover, AR games enables users to create their own virtual people or objects, have them located in a specific place in the real world, and interact with them in real time[32] (Figure 14).

Figure 14: Examples of using AR interaction games in Karnak Temples in Luxor.

2.6 Enhancing kids' experiences:

Location-based AR games is a very effective way to involve and engage kids in tours, as most kids spend a great deal of time playing digital games through their smart devices. Location-based AR games could be applied at *Philae* island or New *Kalabsha* island in Aswan; animated 3D models and various info-graphics about the two islands can helps kids to know more about their locations, detections and elements easily, placing quests and questions about each location and showing descriptions and images to interact with every element throughout the whole area of the islands (Figure 15). By location-based AR game , we can create a competition for kids to find a scene or a sign on the walls of the sanctuary at New *Kalabsha* island or inside Trajan's Kiosk at *Philae* island.

Figure 15: The Speaking Celt[33]; AR app in the Museum of Celtic Heritage in Salzburg, Austria, https://ai2-s2-public.s3.amazonaws.com/figures/2017-08-08/f28af95df61fa968bac530a40349cc454f8c3809/6-Figure3-1.png - visited on 17/04/2019.

3. Conclusion:

AR technology comes to be progressively available and thus increasingly widespread. Although the rising use of augmented reality in many business fields of the modern time, augmented reality in tourist guidance is still new and unsettled. However, possibilities of AR in tourist guidance are great, providing new ways of guidance as tour guides get to catch the attention of tourists and motivate them better, while tourists get new tools to visualize their complex concepts, as well as obtain practical skills. The potential of combining smartphones and augmented reality for tourist guidance is positive, though it still has to be fully discovered.

This study sheds light on how to implement AR promising technology in tourism settings and utilize it to improve the guidance techniques, but adopting AR in tourist guidance is still quite challenging because of issues with its integration with traditional guidance methods, costs for the development and maintenance of the AR system, and general resistance to new technologies.

Overall, the future of AR as a visualization technology looks positive; recently, there have been more attempts to broaden the use of AR in tourist guidance and new AR tools for tourist guidance will continue to be developed as the technology becomes more highly evolved and advanced than ever before. In addition to that, there are a great number of studies going on to improve the compatibility and applicability of AR into tourist guidance.

تقنية الواقع المعزز في مجال لإرشاد السياحي

حازم محمد سيد فراج

المستخلص

تقنية الواقع المعزز هي تجربة تفاعلية رقمية مع البيئة الواقعية حيث تعزز الأشياء الموجودة في العالم الحقيقي بمعلومات رقمية أنتجتها قواعد بيانات الأجهزة الحاسوبية. ولتقنية الواقع المعزز قابلية كبيرة للتطبيق والإستخدام في الكثير من مجالات السياحة ومن أبرز هذه المجالات مجال الإرشاد السياحي.

وسوف يستعرض هذا البحث الأبعاد الأساسية لتقنية الواقع المعزز وفوائد تطبيقها في مجال الإرشاد السياحي وتحسين آداء المرشد السياحي. ورغم وجود العديد من الأدوات الهامة لتطبيق تقنية الواقع المعزز في مجال الإرشاد السياحي وتقديم طرق جديدة ومبتكرة له تظل هذه التقنية جديدة وغير ثابتة.

الكلمات الدلالية:

تقنية الواقع المعزز- النماذج (المجسمات) ثلاثية الأبعاد- السياحة- الإرشاد السياحي- الموقع التراثي- المتحف- التجول- التطبيقات- ألعاب تقنية الواقع المعزز.

Endnotes:

[1] Lu, Junyu and Xu, Zixuan, «Can Virtual Tourism Aid in the Recovery of Tourism Industry in the COVID-19 Pandemic?», *Travel and Tourism Research Association: Advancing Tourism Research Globally* 67, 2021, p. 1.

[2] Bonetti, F., Warnaby, G. & Quinn, L., «Augmented Reality and Virtual Reality in Physical and Online Retailing: A Review, Synthesis and Research Agenda», in: Tim Jung & Tom Dieck M. C. (eds.), *Augmented Reality and Virtual Reality: Empowering Human, Place and Business*, Cham, 2018, pp. 119-132.

[3] Zhou, F., Duh, H. & Billinghurst, M., «Trends in Augmented Reality Tracking, Interaction and Display: A Review of Ten Years of ISMAR», in: *Proceedings of the 7th IEEE/ACM International Symposium on Mixed and Augmented Reality*, Cambridge, 2008, pp. 193-202; Chang, G., Morreale, P., & Medicherla, P., «Applications of Augmented Reality Systems in Education», in: D. Gibson & B. Dodge (eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference*, San Diego, 2010, pp. 1380-1385.

[4] Rauschnabel, P. A., & Ro, Y. K., «Augmented Reality Smart Glasses: An Investigation of Technology Acceptance Drivers», *International Journal of Technology Marketing* 11(2), 2016, pp. 123–148; Alan Craig, *Understanding Augmented Reality: Concepts and Applications*, San Francisco, 2013, p. 25.

[5] Geotagging: refers to the attaching of geographic coordinate information to images, video, and other media recorded by smartphones or GPS-enabled electronic devices.

[6] Choubassi, M. et al., «An Augmented Reality Tourist Guide on Your Mobile Devices», in: Boll, S. et al., (eds.), *Advances in Multimedia Modeling* 5916, 2010, Berlin, pp. 588-602.

[7] Milgram, P. et al., «Augmented Reality: A Class of Displays on the Reality-Virtuality Continuum», *Telemanipulator and Telepresence Technologies* 2351, 1994, p. 283.

[8] Tussyadiah, I. P. et al., «Virtual Reality, Presence, and Attitude Change: Empirical Evidence from Tourism», *Tourism Management* 66, 2018, pp. 140-154.

[9] Yung, R., & Khoo-Lattimore, C., «New Realities: a Systematic Literature Review on Virtual Reality and Augmented Reality in Tourism Research», *Current Issues in Tourism* 22/17, 2019, pp. 2056-2081; Sagar Chavan, «Augmented Reality vs. Virtual Reality: Differences and Similarities», *International Journal of Advanced Research in Computer Engineering & Technology* 5/6, 2016, pp. 1-6.

[10] Shin, Hyejo Hailey & Miyoung Jeong, «Travelers' Motivations to Adopt Augmented Reality (AR) Applications in a Tourism Destination», *Journal of Hospitality and Tourism Technology* 12/2, 2021, p. 390; Chung, N., Heejeong H., Youhee J., «Tourists' Intention to Visit a Destination: The Role of Augmented Reality (AR) Application for A Heritage Site», *Computers in Human Behavior* 50, 2015, pp. 588-599.

[11] Puyuelo, M. et al., «Experiencing Augmented Reality as An Accessibility Resource in The UNESCO Heritage Site Called "la lonja", Valencia», *Procedia Computer Science* 25, 2013, pp. 171–178.

[12] For more information about the Karnak Temple Complex see; Blyth, Elizabeth, *Karnak: Evolution of a Temple*, Routledge, 2006.

[13] For more information about the Ancient Egyptian gods and goddesses see; Hart, George, *The Routledge Dictionary of Egyptian Gods and Goddesses*, Routledge, 2005; Pinch, Geraldine, *Egyptian Mythology: A Guide to the Gods, Goddesses, and Traditions of Ancient Egypt*, New York, 2004.

[14] Chang, Y.L. et al., «Apply an Augmented Reality in a Mobile Guidance to Increase Sense of Place for Heritage Places», *Journal of Educational Technology & Society* 18/2, 2015, pp. 166-178; Chung, N. et al., «The Role of Augmented Reality for Experience-Influenced Environments: The Case of Cultural Heritage Tourism in Korea», *Journal of Travel Research* 57/5, pp. 627–643.

[15] For more information about the Giza Plateau see; Reisner, G. A., *A History of the Giza Necropolis*, 1-2, Cambridge-London, 1942-55; Hassan, S., *Excavations at Giza*, 1-10, Cairo, 1932-60; Junker, H., *Giza*, 1-12, Vienna-Leipzig, 1929-55.

[16] Jung, T., Chung, N., & Leue, M. C., «The Determinants of Recommendations to Use Augmented Reality Technologies: The Case of a Korean Theme Park», *Tourism Management* 49, 2015, pp. 75-86.

[17] For more information about the Great Pyramid at Giza see; Taylor, John, *The Great Pyramid*, Cambridge, 2014; Smith, Craig B., and Zawi Hawass, *How the Great Pyramid was Built*, Washington, D.C., 2018.

[18] Fiore, A. et al., «Augmented Reality for Allowing Time Navigation in Cultural Tourism Experiences: a Case Study», in: *Proceedings of the First International Conference on Augmented and Virtual Reality*, 2014, pp. 296-301.

[19] For more information about Downtown Cairo see; Mynetti, Cynthia, *Paris along the Nile: Architecture in Cairo from Belle Epoque*, Cairo, 1999; Raymond Andŕé, *Cairo: City of History*, Cairo, 2001; Hawas, S., *Khedivian Cairo: Identification and Documentation of Urban-Architecture in Downtown Cairo*, Cairo, 2001.

[20] Jung, T. et al., «Effects of Virtual Reality and Augmented Reality on Visitor Experiences in Museum», *Information and Communication Technologies in Tourism*, 2016, pp. 621–635.

[21] Yoon, S.A. et al., «Using Augmented Reality and Knowledge-Building Scaffolds to Improve Learning in a Science Museum», *International Journal of Computer-Supported Collaborative Learning* 7/4, 2012, pp. 519-541.

[22] Sugiura, et al., «The Use of Augmented Reality Technology in Medical Specimen Museum Tours», *Anatomical Sciences Education*, 2018, pp. 1-11.

[23] **Skin and Bones**: is a mobile app that brings skeletons to life at the Smithsonian's Natural History Museum in Washington, D.C., https://itunes.apple.com/us/app/skin-bones/id929733243?mt=8

[24] Kondo, T., «Augmented Learning Environment Using Mixed Reality Technology», in: Reeves, T. & Yamashita, S. (eds.), *Proceedings of E-Learn 2006 - World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education*, Honolulu, 2006, pp. 83-87.

[25] **The Wall of Knowledge:** is a mobile AR app, available at https://play.google.com/store/apps/details?id=com.WoK.WoK&hl=en (visited on 09/03/2019).

[26] For more information about the Papyrus of Ani see; Andrews, Carol, and James Wasserman, *The Egyptian Book of the Dead: The Book of Going Forth by Day-The Complete Papyrus of Ani Featuring Integrated Text and Full-Color Images*, San Francisco, 2008.

[27] Pokémon Go is an augmented reality (AR) mobile game developed and published in 2016, For more information about Pokémon Go see; https://en.wikipedia.org/wiki/Pok%C3%A9mon_Go.

[28] Ajay Aluri, «Mobile Augmented Reality (MAR) Game as a Travel Guide: Insights from Pokémon GO», *Journal of Hospitality and Tourism Technology* 8/1, 2017, pp. 55-72.

[29] Google Translate: is an augmented reality translation application developed by Google, the app is available at https://itunes.apple.com/us/app/google-translate/id414706506?mt=8 (visited on 19/04/2019).

[30] Abe, Shinya, Ryo Sasaki, and Kayoko Yamamoto, «Sightseeing Support System with Augmented Reality and No Language Barriers», *Urban Informatics and Future Cities*, Cham, 2021. pp. 591-611.

[31] For more information about the Valley of the Kings see; Richard H. Wilkinson, Kent R. Weeks, *The Oxford Handbook of the Valley of the Kings*, Oxford, 2019.

[32] Graells-Garrido, E. et al., «The Effect of Pokémon Go on the Pulse of the City: a Natural Experiment», *EPJ Data Science* 6/1, 2017, pp. 1-23; Mortara, M. et al., «Learning Cultural Heritage by Serious Games», *Journal of Cultural Heritage* 15/3, 2014, pp. 318-325.

[33] **The Speaking Celt**; is an Augmented Reality companion app for visiting the Museum of Celtic Heritage in Hallein, Pflegerplatz 5, Salzburg, Austria, the app is available at https://play.google.com/store/apps/Details?id=technology.schneeweis.keltenmuseumhalleinapp&hl=en (visited on 19/04/2019).

Bibliography

Abe, Shinya, Ryo Sasaki, and Kayoko Yamamoto, «Sightseeing Support System with Augmented Reality and No Language Barriers», *Urban Informatics and Future Cities*, Cham, 2021. pp. 591-611.

Ajay Aluri, «Mobile Augmented Reality (MAR) Game as a Travel Guide: Insights from Pokémon GO», *Journal of Hospitality and Tourism Technology* 8/1, 2017, pp. 55-72.

Alan Craig, *Understanding Augmented Reality: Concepts and Applications*, San Francisco, 2013.

Andrews, Carol, and James Wasserman, *The Egyptian Book of the Dead: The Book of Going Forth by Day-The Complete Papyrus of Ani Featuring Integrated Text and Full-Color Images*, San Francisco, 2008.

Blyth, Elizabeth, *Karnak: Evolution of a Temple*, Routledge, 2006.

Bonetti, F., Warnaby, G. & Quinn, L., «Augmented Reality and Virtual Reality in Physical and Online Retailing: A Review, Synthesis and Research Agenda», in: Tim Jung & Tom Dieck M. C. (eds.), *Augmented Reality and Virtual Reality: Empowering Human, Place and Business.* Cham, 2018, pp. 119-132.

Chang, G., Morreale, P., & Medicherla, P., «Applications of Augmented Reality Systems in Education», in: D. Gibson & B. Dodge (eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference*, San Diego, 2010, pp. 1380-

1385.
Chang, Y.L., Hou, H.T., Pan, C.Y., Sung, Y.T., Chang, K.E., «Apply an Augmented Reality in a Mobile Guidance to Increase Sense of Place for Heritage Places», *Journal of Educational Technology & Society* 18/2, 2015, pp. 166-178.
Choubassi, M., Nestares, O., Wu, Y., Kozintsev, I., Haussecker, H., «An Augmented Reality Tourist Guide on Your Mobile Devices», in: Boll, S., Tian, Q., Zhang, L., Zhang, Z., Chen, P. (eds.), *Advances in Multimedia Modeling* 5916, 2010, Berlin, pp. 588-602.
Chung, N., Heejeong H., Youhee J., «Tourists' Intention to Visit a Destination: The Role of Augmented Reality (AR) Application for a Heritage Site», *Computers in Human Behavior* 50, 2015, pp. 588-599.
Chung, N., Lee, H., Kim, J.-Y., & Koo, C., «The Role of Augmented Reality for Experience-Influenced Environments: The Case of Cultural Heritage Tourism in Korea», *Journal of Travel Research* 57/5, pp. 627–643.
Fiore, A., Luca M., Luigi M., Palmalisa M., «Augmented Reality for Allowing Time Navigation in Cultural Tourism Experiences: a Case Study», in: *Proceedings of the first International Conference on Augmented and Virtual Reality*, 2014, pp. 296-301.
Graells-Garrido, E., Ferres, L., Caro, D., & Bravo, L., «The Effect of Pokémon Go on the Pulse of the City: a Natural Experiment», *EPJ Data Science* 6/1, 2017, pp. 1-23;
Hart, George, *The Routledge Dictionary of Egyptian Gods and Goddesses*, Routledge, 2005.
Hassan, S., *Excavations at Giza*, 1-10, Cairo, 1932-60.
Hawas, S., *Khedivian Cairo: Identification and Documentation of Urban-Architecture in Downtown Cairo*, Cairo, 2001.
Jung, T., Chung, N., & Leue, M. C., «The Determinants of Recommendations to Use Augmented Reality Technologies: The case of a Korean Theme Park», *Tourism Management* 49, 2015, pp. 75-86.
Jung, T., Tom Dieck, M. C., Lee, H., & Chung, N., «Effects of Virtual Reality and Augmented Reality on Visitor Experiences in Museum», *Information and communication technologies in tourism*, 2016, pp. 621–635.
Junker, H., *Giza*, 1-12, Vienna-Leipzig, 1929-55.
Kondo, T., «Augmented Learning Environment Using Mixed Reality Technology», in: Reeves, T. & Yamashita, S. (eds.), *Proceedings of E-Learn 2006 - World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education*, Honolulu, 2006, pp. 83-87.
Lu, Junyu and Xu, Zixuan, «Can Virtual Tourism Aid in the Recovery of Tourism Industry in the COVID-19 Pandemic?», *Travel and Tourism Research Association: Advancing Tourism Research Globally* 67, 2021, pp. 1-7.
Milgram, P., Takemura, H., Utsumi, A., Kishino, F., «Augmented Reality: A Class of Displays on the Reality-Virtuality Continuum», *Telemanipulator and Telepresence Technologies* 2351, 1994, pp. 282-293.
Mortara, M., Catalano, C., Bellotti, F., Fiucci, G., Houry-Panchetti, M., Petridis, P., «Learning Cultural Heritage by Serious Games», *Journal of Cultural Heritage* 15/3, 2014, pp. 318-325.
Mynetti, Cynthia, *Paris along the Nile: Architecture in Cairo from Belle Epoque*, Cairo, 1999.
Pinch, Geraldine, *Egyptian Mythology: A Guide to the Gods, Goddesses, and Traditions of Ancient Egypt*, New York, 2004.
Puyuelo, M., Higón, J. L., Merino, L., & Contero, M., «Experiencing Augmented Reality as an Accessibility Resource in the UNESCO Heritage Site Called "la lonja", Valencia», *Procedia Computer Science* 25, 2013, pp. 171–178.
Rauschnabel, P. A., & Ro, Y. K., «Augmented Reality Smart Glasses: An Investigation of

Technology Acceptance Drivers», *International Journal of Technology Marketing* 11(2), 2016, pp. 123–148.
Raymond Andréé, *Cairo: City of History*, Cairo, 2001.
Reisner, G. A., *A History of the Giza Necropolis*, 1-2, Cambridge-London, 1942-55.
Richard H. Wilkinson, Kent R. Weeks, *The Oxford Handbook of the Valley of the Kings*, Oxford, 2019.
Sagar Chavan, «Augmented Reality vs. Virtual Reality: Differences and Similarities», *International Journal of Advanced Research in Computer Engineering & Technology* 5/6, 2016; pp. 1-6.
Shin, Hyejo Hailey, and Miyoung Jeong, «Travelers' Motivations to Adopt Augmented Reality (AR) Applications in a Tourism Destination», *Journal of Hospitality and Tourism Technology* 12/2, 2021, pp. 389-405.
Smith, Craig B., and Zawi Hawass, *How the Great Pyramid was Built*, Washington, D.C., 2018.
Sugiura, A., Kitama, T., Toyoura, M., Mao, X., «The Use of Augmented Reality Technology in Medical Specimen Museum Tours», *Anatomical Sciences Education*, 2018, pp. 1-11.
Taylor, John, *The Great Pyramid*, Cambridge, 2014.
Tussyadiah, I. P., Wang, D., Jung, T. H., & tom Dieck, M. C., «Virtual Reality, Presence, and Attitude Change: Empirical Evidence from Tourism», *Tourism Management* 66, 2018, pp. 140-154.
Yoon, S.A., Elinich, K., Wang, J., Steinmeier, C., Tucker, S., «Using Augmented Reality and Knowledge-Building Scaffolds to Improve Learning in a Science Museum», *International Journal of Computer-Supported Collaborative Learning* 7/4, 2012, pp. 519-541.
Yung, R., & Khoo-Lattimore, C., «New Realities: a Systematic Literature Review on Virtual Reality and Augmented Reality in Tourism Research», *Current Issues in Tourism* 22/17, 2019, pp. 2056-2081.
Zhou, F., Duh, H. & Billinghurst, M., «Trends in Augmented Reality Tracking, Interaction and Display: A Review of Ten Years of ISMAR», in: *Proceedings of the 7th IEEE/ACM International Symposium on Mixed and Augmented Reality*, Cambridge, 2008, pp. 193-202.