Connecting historic photographs with the modern landscape

Michalis Foukarakis[1], Orestis Faltakas[1], Giannis Frantzeskakis[1], Emmanouil Ntafotis[1], Emmanouil Zidianakis[1], Eirini Kontaki[1], Constantina Manoli[1], Stavroula Ntoa[1], Nikolaos Partarakis[1], and Constantine Stephanidis[1,2]

[1] Institute of Computer Science, Foundation for Research and Technology—Hellas (FORTH), 70013 Heraklion, Crete, Greece;
[2] Computer Science Department, School of Sciences & Engineering, University of Crete, 70013 Heraklion, Crete, Greece

{foukas, faltakas, giannisf, ntafotis, zidian, ekontaki, cmanoli, stant, partarak, cs} @ics.forth.gr

Abstract: We present a mobile application that is bringing to life historic photographs of Heraklion by mapping them in historical routes within the city and offering the visitor a dialogue with its social and historical context. At the same time while visiting the public library where these historic photographs are exhibited, the mobile app enhances the provided information by virtually replacing the photographs with alternative views from different historic periods.

Keywords: Augmented Reality, Mobile technology, Mobile Guides, Cultural Heritage

1. Introduction

The invention of photography, more than one and a half-century in the past, revolutionised the way we capture and communicate reality. This new form of communication arrived in Crete, Greece in a troubled period of the Cretan State (1898-1913). Several photographs taken during this period were used to create postcards used mainly by soldiers sending their news back home. These postcards today are an important part of the Cretan cultural heritage and are considered a window into the past as they allow us to virtually visit locations and sites altered in the modern appearance of the island.

For a long time this treasure, possessed by the Municipal Library of Heraklion, has been on display and its digital version can be found on the web. In this work, we move a step further by geolocalising these historical sources in the city of Heraklion, allowing modern visitors to explore these sources at their place of photographic origin. This is done through a mobile app available for download through the device app store.

2. Background and related work

Designing mobile applications for the presentation of multimedia collections requires appropriate browsing and visualization approaches, because several new forms of querying are available, such as localization and RGB-based image features detection by utilizing the photographic sensor of the devices. As a consequence, a mobile app can create more interesting user experiences, by supporting queries such as "Retrieve all the images relevant to the location I'm currently in" [1]. Another consideration that should be taken into account is the screen size of the device and the interaction style, which means that all interactions should be meaningful and information should be attractive and intuitive [2,3].

At the same time, Augmented Reality (AR) [4-6], a research domain for three decades that found a new ground of application through the evolution of mobile devices, can be used to create compelling encounters with photographs of the past. More specifically, using Mobile Augmented Reality the results of these queries can be visualized in place and even blended with the reality as seen by the user's camera [7, 8]. With this novel approach, a tourism information provision system can enhance information provision before, during and after the visit. Furthermore, while visitors are in a destination such systems can augment the physical landscape with information by integrating visual information to the video stream retrieved by the mobile device camera [9].

Today approaches that blend reality with digital content are exploited both in the cultural and tourism sectors [10-15]. Some of these approaches combine mobile AR with a web information system. Thus when at home, visitors may use the web to access information which is in turn augmented when using the mobile while visiting the actual site [16,17]. Finally, in the AR domain using 3D content and virtual humans has made possible the revival of the past through the physical remains of the present (e.g. daily life at Pompei) [18-24].

In this work, motivated by the potential offered through the augmentation of physical paper with digital information [25, 26], we build on the state of the art in mobile technology applied in the domain of tourism and culture [27-29] and its application in real-world scenarios [30, 31]. As such we propose a system that digitally augments and brings to life historic postcards. The developed mobile application provides a twofold augmentation by presenting postcards from the past when visiting the city centre of Heraklion, and by augmenting the exhibition room of the Vikelaia municipality public library by virtually replacing the post-cards with other historic photographs or photographs of the modern landscape from the location of the postcard.

3. Overview of the tour guide

Vikelaia Postcards is a mobile app that provides an AR-powered presentation of postcards from the audiovisual archive of the city of Heraklion's public Vikelaia library. The app also offers city route suggestions for visiting historical landmarks, buildings and important locations.

The Vikelaia library owns a significant amount of new and old postcards which are displayed in an exhibition room. The majority of them are old photographs from places around the city, including famous streets, squares, the Venetian port, gardens, etc. The app offers an interactive map of the exhibition room that shows where each postcard is located. Visitors can use the app to view detailed information for each postcard exhibit and open the city map to see where each postcard's location resides in the city.

Every postcard displayed in the library can be brought to life by interacting with it through the device's camera and viewing its contents through a different lens. Some of them are transformed into different versions of the same landmark or location, while others are replaced by images of their modern-day status, highlighting the difference between then and now.

For users that want to see the modern-day locations that are depicted in the postcards, the app suggests three different routes through the city, each with several stops that highlight the most important sights depicted in the postcards. Walking directions are also available to facilitate the tour.

The application is multiplatform and runs on iOS and Android phones and tablets. On iOS, it is written in the Swift language [32], using the latest SwiftUI framework [33]. Augmented Reality features are powered by the RealityKit framework. On Android, it is written in Kotlin [34], using standard Android mobile development practices. Augmented reality features are powered by the AR Core framework [35]. Both versions of the app share a common JSON data source containing information on postcards, routes and localized strings in both Greek and English. The Google Maps API [36] is used to integrate the city map and its markers into the application.

4. UI overview

The main page of the application provides the available options for interacting with the collection of the municipal library (see Figure 1, a). From these options, the „Bring the postcard to life" and „Then and now" provide different forms of augmentation. A typical usage scenario is illustrated in Figure 1 (b and c) where the user is selecting a postcard from the list to access its details while having the option to activate AR for further augmentation. Another provided option is the localisation of the postcard on the map of the city centre of Heraklion as shown in Figure 1 (d).

The city tour options are structured in a collection of alternative tours that the user can take to explore different aspects of the city both today and in the past. The tour is visualised on the mobile device providing also a suggested path within the city. When on the move the user's location is also visualised by using the GPS data from the mobile device.
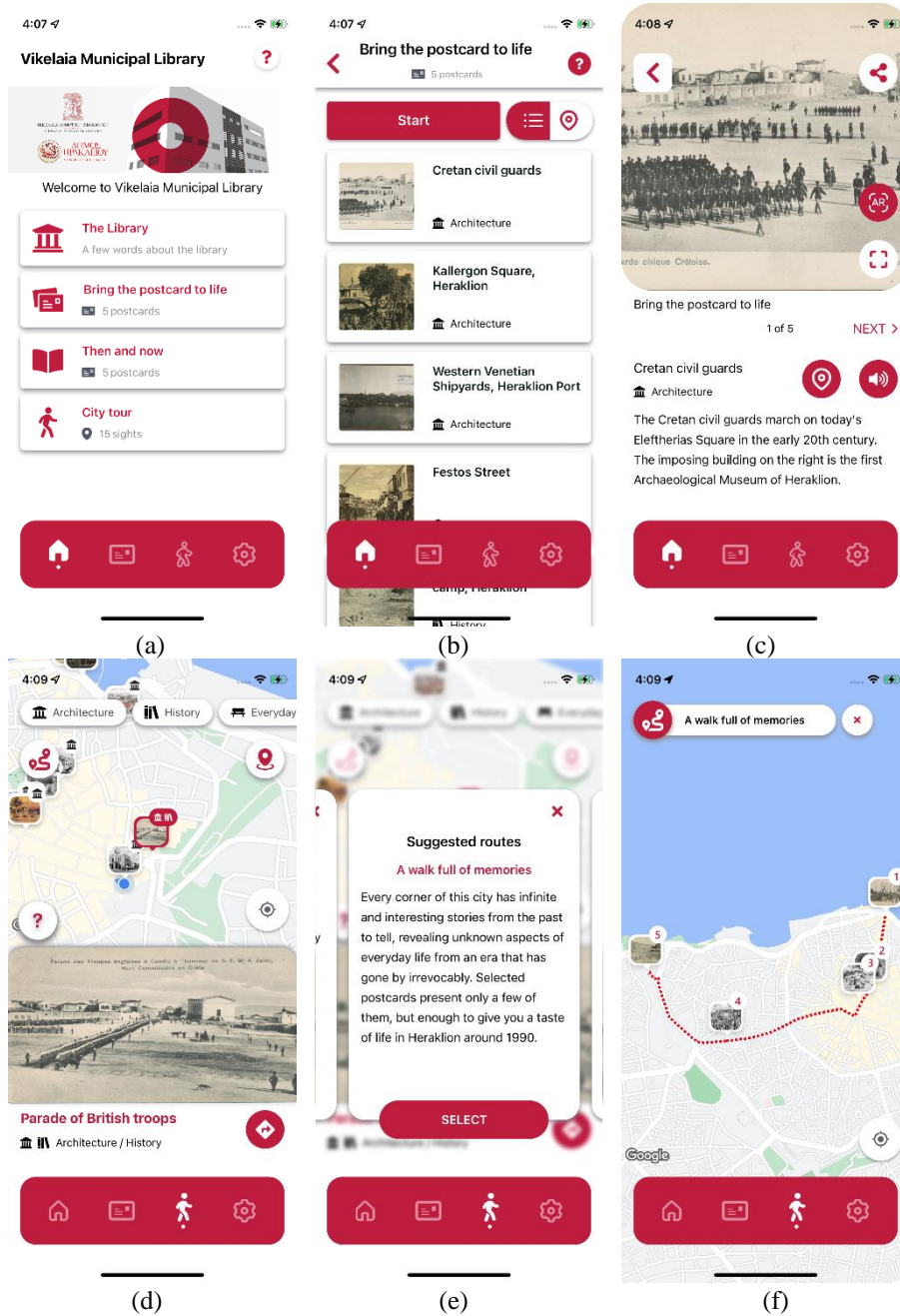
Figure 1. (a) Mobile App home page, (b) Selecting a postcard, (c) Postcard visualisation, (d) Localising postcards in the city, (e) Available routes, (f) Route visualisation on the city map.

5. Evaluation results

The application has been developed following an iterative design approach, alternating prototype development with expert-based evaluation, with the involvement of User experience (UX) experts and curators from the Vikelaia Municipal Library. The expert-based evaluation was conducted based on the 10 heuristic guidelines [37], but also on heuristic guidelines for mobile design [38] and mobile AR [39]. The problems identified throughout the various iterations fall into four major categories: user guidance, navigation, interaction, and AR UX.

In terms of user guidance, it was pointed out that succinct instructions should be provided for each AR functionality supported, allowing users to clearly understand how they can initiate the AR experience and manipulate the virtual objects, thus supporting them to fully engage with the AR content. Clear instructions were also important for the city tour component, allowing users to understand how to personalize the experience.

Regarding navigation, issues mostly pertained to the usability of the city navigation part, ensuring that information is consistently provided regarding the user's current location and orientation, nearby points of interest (POIs), and route from one POI to another. Navigation in the short tours provided in the Library was also scrutinized to safeguard that users could successfully start a tour, pause, and resume it according to their needs.

Interaction issues concerned primarily AR interactions, ensuring the accurate recognition of AR-augmented postcards, system responsiveness to user actions for initiating the AR functionality, short loading time, and adaptation to the user's position and camera movements.

Finally, AR UX considerations focused mainly on the discoverability and findability of AR features, the visibility of UI elements across different backgrounds, the minimization of UI to make sure that it does not interfere with the AR experience, and the alignment of the physical and virtual worlds.

6. Conclusion

In this paper, we have presented a simple, yet efficient approach to using historic photography to provide an alternative form of visiting experience to the visitors of the city centre of Heraklion. The approach uses modern AR features to present historic photographs in the place where they were taken, thus opening a dialogue between the present and the past. This dialogue also connects with the location within the city where these historic photographs are on display providing even further features by replacing the past with the present or providing views from other historic periods in a photographic timeline of captured moments of history.

Acknowledgement

References

1. Sauter, L., Rossetto, L., & Schuldt, H. (2018, December). Exploring cultural heritage in augmented reality with gofind!. In *2018 IEEE International Conference on Artificial Intelligence and Virtual Reality (AIVR)* (pp. 187-188). IEEE.
2. Garcia-Lopez, E., Garcia-Cabot, A., de-Marcos, L., & Moreira-Teixeira, A. (2021). An experiment to discover usability guidelines for designing mobile tourist apps. *Wireless Communications and Mobile Computing*, *2021*, 1-12.
3. Shukri, S. A. I. A., Arshad, H., & Abidin, R. Z. (2017, October). The design guidelines of mobile augmented reality for tourism in Malaysia. In *AIP Conference Proceedings* (Vol. 1891, No. 1, p. 020026). AIP Publishing LLC.
4. Azuma, R. T. (1997). A survey of augmented reality. *Presence: teleoperators & virtual environments*, *6*(4), 355-385.
5. Carmigniani, J., & Furht, B. (2011). Augmented reality: an overview. *Handbook of augmented reality*, 3-46.
6. Papagiannakis, G., Singh, G., & Magnenat-Thalmann, N. (2008). A survey of mobile and wireless technologies for augmented reality systems. *Computer Animation and Virtual Worlds*, *19*(1), 3-22.
7. Cavallo, M., Rhodes, G. A., & Forbes, A. G. (2016, September). Riverwalk: Incorporating historical photographs in public outdoor augmented reality experiences. In *2016 IEEE International Symposium on Mixed and Augmented Reality (ISMAR-Adjunct)* (pp. 160-165). IEEE.
8. Rainio, K., Honkamaa, P., & Spilling, K. (2015). Presenting Historical Photos using Augmented Reality. *ARea*, *15*, 11-12.
9. Jingen Liang, L., & Elliot, S. (2021). A systematic review of augmented reality tourism research: What is now and what is next?. *Tourism and Hospitality Research*, *21*(1), 15-30.
10. Tscheu, F., & Buhalis, D. (2016). Augmented reality at cultural heritage sites. In Information and Communication Technologies in Tourism 2016: Proceedings of the International Conference in Bilbao, Spain, February 2-5, 2016 (pp. 607-619). Springer International Publishing.
11. tom Dieck, M. C., & Jung, T. H. (2017). Value of augmented reality at cultural heritage sites: A stakeholder approach. *Journal of Destination Marketing & Management*, *6*(2), 110-117.
12. Casella, G., & Coelho, M. (2013, July). Augmented heritage: situating augmented reality mobile apps in cultural heritage communication. In *Proceedings of the 2013 International Conference on Information Systems and Design of Communication* (pp. 138-140).
13. Choudary, O., Charvillat, V., Grigoras, R., & Gurdjos, P. (2009, October). MARCH: mobile augmented reality for cultural heritage. In *Proc*
14. Angelopoulou, A., Economou, D., Bouki, V., Psarrou, A., Jin, L., Pritchard, C., & Kolyda, F. (2012). Mobile augmented reality for cultural heritage. In *Mobile Wireless Middleware, Operating Systems, and Applications: 4th International ICST Conference, Mobilware 2011,*

London, UK, June 22-24, 2011, Revised Selected Papers 4 (pp. 15-22). Springer Berlin Heidelberg.

15. Stricker, D., Dähne, P., Seibert, F., Christou, I. T., Almeida, L., Carlucci, R., & Ioannidis, N. (2001). Design and development issues for archeoguide: An augmented reality based cultural heritage on-site guide.

16. Mathioudakis, G., Klironomos, I., Partarakis, N., Papadaki, E., Volakakis, K., Anifantis, N., ... & Stephanidis, C. (2022). InCulture: A Collaborative Platform for Intangible Cultural Heritage Narratives. *Heritage*, *5*(4), 2881-2903.

17. Mathioudakis, G., Klironomos, I., Partarakis, N., Papadaki, E., Anifantis, N., Antona, M., & Stephanidis, C. (2021). Supporting Online and On-Site Digital Diverse Travels. *Heritage*, *4*(4), 4558-4577.

18. Machidon, O. M., Duguleana, M., & Carrozzino, M. (2018). Virtual humans in cultural heritage ICT applications: A review. *Journal of Cultural Heritage*, *33*, 249-260.

19. Papagiannakis, G., Schertenleib, S., Ponder, M., Arévalo, M., Magnenat-Thalmann, N., & Thalmann, D. (2004). Real-time virtual humans in ar sites. In *1st European Conference on Visual Media Production (CVMP)* (No. CONF, pp. 273-276).

20. Magnenat-Thalmann, N., Papagiannakis, G., & Chaudhuri, P. (2008). Applications of interactive virtual humans in mobile augmented reality. *Encyclopaedia of Multimedia, 2nd edn. Springer*.

21. Karuzaki, E., Partarakis, N., Patsiouras, N., Zidianakis, E., Katzourakis, A., Pattakos, A., ... & Zabulis, X. (2021). Realistic virtual humans for cultural heritage applications. *Heritage*, *4*(4), 4148-4171.

22. Carre, A. L., Dubois, A., Partarakis, N., Zabulis, X., Patsiouras, N., Mantinaki, E., ... & Manitsaris, S. (2022). Mixed-reality demonstration and training of glassblowing. *Heritage*, *5*(1), 103-128.

23. Stefanidi, E., Partarakis, N., Zabulis, X., & Papagiannakis, G. (2020, November). An approach for the visualization of crafts and machine usage in virtual environments. In *Proceedings of the 13th International Conference on Advances in Computer-Human Interactions, Valencia, Spain* (pp. 21-25).

24. 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.

25. Margetis, G., Ntoa, S., Antona, M., & Stephanidis, C. (2019). Augmenting natural interaction with physical paper in ambient intelligence environments. Multimedia Tools and Applications, 78, 13387-13433.

26. Woods, E., Billinghurst, M., Looser, J., Aldridge, G., Brown, D., Garrie, B., & Nelles, C. (2004, June). Augmenting the science centre and museum experience. In Proceedings of the 2nd international conference on Computer graphics and interactive techniques in Australasia and South East Asia (pp. 230-236).

27. Kim, D., & Kim, S. (2017). The role of mobile technology in tourism: Patents, articles, news, and mobile tour app reviews. *Sustainability*, *9*(11), 2082.

28. Law, R., Chan, I. C. C., & Wang, L. (2018). A comprehensive review of mobile technology use in hospitality and tourism. *Journal of Hospitality Marketing & Management*, *27*(6), 626-648.

29. Dorcic, J., Komsic, J., & Markovic, S. (2019). Mobile technologies and applications towards smart tourism–state of the art. *Tourism Review*, *74*(1), 82-103.

30. Partarakis, N., Kontaki, E., Zidianakis, E., Drossis, G., Birliraki, C., Metaxakis, G., ... & Stephanidis, C. (2018). Digital Heritage Technology at the Archaeological Museum of He-

raklion. In *HCI International 2018–Posters' Extended Abstracts: 20th International Conference, HCI International 2018, Las Vegas, NV, USA, July 15-20, 2018, Proceedings, Part III 20* (pp. 196-203). Springer International Publishing.

31. Partarakis, N., Margetis, G., Zidianakis, E., Sifakis, M., Drossis, G., Birliraki, C., ... & Stephanidis, C. (2018). Interactive city information point: your guide to Heraklion city. In *HCI International 2018–Posters' Extended Abstracts: 20th International Conference, HCI International 2018, Las Vegas, NV, USA, July 15-20, 2018, Proceedings, Part III 20* (pp. 204-212). Springer International Publishing.

32. Swift. Available online: https://developer.apple.com/swift/, (accessed on 15 February 2023)

33. SwiftUI. Available online: https://developer.apple.com/xcode/swiftui/, (accessed on 15 February 2023)

34. Kotlin. Available online: https://kotlinlang.org/, (accessed on 15 February 2023)

35. ARCORE. Available online: https://arvr.google.com/arcore/, (accessed on 15 February 2023)

36. Google maps platform. Available online: https://developers.google.com/maps, (accessed on 15 February 2023)

37. Nielsen, J. (1994, April). Enhancing the explanatory power of usability heuristics. In Proceedings of the SIGCHI conference on Human Factors in Computing Systems (pp. 152-158).

38. Yáñez Gómez, R., Cascado Caballero, D., & Sevillano, J. L. (2014). Heuristic evaluation on mobile interfaces: A new checklist. The Scientific World Journal, 2014.

39. Endsley, T. C., Sprehn, K. A., Brill, R. M., Ryan, K. J., Vincent, E. C., & Martin, J. M. (2017, September). Augmented reality design heuristics: Designing for dynamic interactions. In Proceedings of the human factors and ergonomics society annual meeting (Vol. 61, No. 1, pp. 2100-2104). Sage CA: Los Angeles, CA: Sage Publications.