Personalising the Museum Experience

Fabian Bohnert

Faculty of Information Technology, Monash University
Clayton, VIC 3800, Australia
fabian.bohnert@monash.edu

Abstract. Visitors to physical museums are often overwhelmed by the vast amount of information available in the space they are exploring, making it difficult to select personally interesting content. In contrast to visits to online museum collections, the selection process is complicated by the facts that (1) it takes time for people to move between exhibits; and (2) exhibitions may be arranged in a way that does not reflect visitors' personal interests, meaning that the interesting exhibits may be scattered throughout the museum. Recent advances in mobile technology and user modelling have enabled computer-based systems that can assist visitors in selecting interesting content. Additionally, such systems can provide visitors with personalised information about exhibits while they are exploring the museum. This paper categorises state-of-the-art technology for personalising visitors' experiences in museums, and discusses current challenges for enabling personalised visitor-support systems.

1 Introduction and Overview

Encouraged by a shift towards more visitor orientation in the 1960s and 1970s, museums have long since evolved from institutions which paid little attention to visitors' needs to places where people go to learn in an enjoyable environment, while seeking information and education about art, science and cultural heritage [1]. Hand in hand with the trend towards visitor focus and engagement goes the provision of differentiated access to information and services tailored to a visitor's specific profile,[1] both in the physical museum and online. This is because viewing personally interesting content encourages visitors' engagement and learning [2, 3]. For example, museums have seen automated self-guided visitor information systems appear and evolve from audio to audio-visual [3], and recently the first attempts have been made to personalise content presentation based on real-time positioning and a visitor's interests, e. g., [4–6].

The research fields of museum informatics, pervasive computing and user modelling have all provided key approaches and technologies to enable personalised museum experiences. They can be categorised as follows.

Types of personalised services. With the goal of providing a more enjoyable experience, personalised visitor-support systems can provide a variety of

[1] The interests and goals of museum visitors depend on a large number of factors, such as visitors' cultural backgrounds, previous experiences and social contexts [2].

services. These services include (1) delivering personalised (multimedia) content about exhibits in the physical museum [5–7], (2) delivering recommendations on personally interesting museum exhibits [8–10], (3) stimulating interaction with the museum environment by linking multimedia content with content in the museum [5], and (4) encouraging social interaction with other museum visitors [11].

Types of user modelling time frame. Personalised visitor-support systems can (1) employ single-visit user models [5–8], (2) access user modelling data that has been acquired before a visit [9], or (3) exploit cross-visit or long-term user models [12]. The challenge for single-visit user models is to adapt to a visitor's interests early during a visit. This adaptation process can be sped up by initialising user models at the beginning of the visit, e. g., by manually bootstrapping the user models [6], or utilising external sources like those from cases (2) and (3).

Types of user model construction. Personalised visitor-support systems for physical museums can employ adaptable user models that require people to explicitly state their interests in some form, e. g., [9]. Alternatively, preferences and interests can be estimated from non-intrusive observations, utilising adaptive user models that do not require explicit visitor input [5–8, 13]. Adaptive visitor-support systems have often primarily updated their user models from visitors' interactions with the system, e. g., [5–7]. Alternatively, user model updates can be based upon non-intrusive observations of visitors' movements through the museum [6, 8, 13, 14].

Types of domain knowledge representation. Visitor-support systems for the museum domain have often used an explicit, a-priori engineered representation of the domain knowledge to enable personalised museum experiences, e. g., [5–7, 9]. Alternative approaches include statistical user modelling techniques, which do not require an explicit domain knowledge representation [8, 13–15]. Such techniques may be advantageous in the context of large museums, where a comprehensive domain knowledge representation may be hard to achieve.

Types of technology. Hardware technologies for personalised visitor-support systems include personal handheld devices such as smartphones [5, 10], embedded computing devices [6], and combinations of the two technologies. For non-intrusive systems based on visitors' movements, these technologies are typically combined with instrumentation for sensing visitors' behaviour (e. g., location and direction) in the museum.

2 Current Challenges

The museum domain (in particular, its physicality) provides specific research challenges for personalised visitor-support systems. Current challenges include the following.

Achieving non-intrusiveness and adaptiveness. While personalised visitor-support systems can initialise their user models by using external user modelling data [12], these user models should also be dynamically updated with the progression of a visit to incorporate additional, site-specific information about visitors. Automatic updates can be achieved by processing non-intrusively obtained sensor information about visitors' movements and behaviour in a museum. User models based on this type of data have already been proposed, e. g., [5, 6, 8, 10, 13, 14], but achieving adaptiveness and context-awareness from location information still poses practical challenges due to the difficulty associated with accurately positioning museum visitors inside museum buildings. Deployment of such systems will require (1) further research in the area of indoor positioning technology to automatically track visitors during their visits, and (2) techniques for linking sensor information with user model input that appropriately consider the impact of measurement noise on the performance of user models (initial research in this area includes [16] and [17]).

Generating personalised content. Many research projects have investigated personalised content delivery systems for museums, e. g., [5–7]. Remaining challenges include achieving increased coherence within personalised presentations, and linking in-situ presentations with direct access to online museum collections.

Generating exhibit recommendations. In contrast to traditional domains for recommender systems, predictions differ from recommendations in physical museums. For example, it may be advisable not to recommend interesting exhibits that are expected to be visited immediately anyway (to avoid annoyance with the system). Similarly, recommendations about interesting exhibits that are far away should be delivered only under extreme circumstances (e. g., if the museum is about to close), in order not to interrupt a visitor's experience. Current solutions for recommending personalised museum tours or exhibit themes do often not consistently consider such factors.

Linking pre-visit, in-situ and post-visit museum experiences. While some researchers have investigated approaches for linking pre-visit, in-situ and post-visit museum experiences, e. g., [5, 9, 18, 19], recent technological developments have generated additional challenges. These challenges include linking in-situ museum experiences with online access to museum collections, and in-situ visitor interaction with online social networking technologies.

Limited computational resources. Handheld devices have limited processing capabilities. Client/server architectures have often been used to carry out computationally expensive operations on a high-capacity server at the backend, but this solution requires wireless connectivity. Server-independent solutions will require resource-efficient software for handheld devices.

3 Final Remarks

This paper provided an assessment of pervasive user modelling and personalisation techniques for personalising the experiences of museum visitors. While previous research projects have already tackled numerous challenges in this domain, many challenges remain and new opportunities have emerged for future research. This paper discussed some of these challenges and opportunities.

References

1. Filippini-Fantoni, S.: Museums with a personal touch. In: Proc. of the 10th EVA London Conf. (EVA-London-03). (2003) 25.1–25.10
2. Falk, J.H.: Identity and the Museum Visitor Experience. Left Coast Press (2009)
3. Tallon, L., Walker, K., eds.: Digital Technologies and the Museum Experience – Handheld Guides and Other Media. AltaMira Press (2008)
4. Proctor, N., Tellis, C.: The state of the art in museum handhelds in 2003. In: Proc. of the 12th Intl. Conf. on Museums and the Web (MW-03). (2003)
5. Stock, O., Zancanaro, M., Busetta, P., Callaway, C., Krüger, A., Kruppa, M., Kuflik, T., Not, E., Rocchi, C.: Adaptive, intelligent presentation of information for the museum visitor in PEACH. UMUAI **18**(3) (2007) 257–304
6. Hatala, M., Wakkary, R.: Ontology-based user modeling in an augmented audio reality system for museums. UMUAI **15**(3-4) (2005) 339–380
7. Petrelli, D., Not, E.: User-centred design of flexible hypermedia for a mobile guide: Reflections on the HyperAudio experience. UMUAI **15**(3-4) (2005) 303–338
8. Bohnert, F., Zukerman, I.: Non-intrusive personalisation of the museum experience. In: Proc. of the 17th Intl. Conf. on User Modeling, Adaptation, and Personalization (UMAP-09). (2009) 197–209
9. Wang, Y., Aroyo, L., Stash, N., Sambeek, R., Schuurmans, Y., Schreiber, G., Gorgels, P.: Cultivating personalized museum tours online and on-site. Interdisciplinary Science Reviews **34**(2) (2009) 141–156
10. van Hage, W.R., Stash, N., Wang, Y., Aroyo, L.: Adaptation step-by-step: Challenges for real-time spatial personalization. In: Proc. of the 2010 Workshop on Pervasive User Modeling and Personalization (PUMP-10 at UMAP-10). (2010)
11. Wakkary, R., Muise, K., Tanenbaum, K., Hatala, M., Kornfeld, L.: Situating approaches to museum guides for families and groups. In: Proc. of the 10th Intl. Cultural Heritage Informatics Meeting (ICHIM-07). (2007)
12. Kuflik, T., Kay, J., Kummerfeld, B.: Life-long personalised museum experiences. In: Proc. of the 2010 Workshop on Pervasive User Modeling and Personalization (PUMP-10 at UMAP-10). (2010)
13. Bohnert, F., Zukerman, I.: Personalised pathway prediction. In: Proc. of the 18th Intl. Conf. on User Modeling, Adaptation, and Personalization (UMAP-10). (2010) 363–368
14. Bohnert, F., Schmidt, D.F., Zukerman, I.: Spatial processes for recommender systems. In: Proc. of the 21st Intl. Joint Conf. on Artificial Intelligence (IJCAI-09). (2009) 2022–2027
15. Zukerman, I., Albrecht, D.W.: Predictive statistical models for user modeling. UMUAI **11**(1-2) (2001) 5–18
16. Carmichael, D.J., Kay, J., Kummerfeld, B.: Consistent modelling of users, devices and sensors in a ubiquitous computing environment. UMUAI **15**(3-4) (2005) 197–234
17. Schmidt, D.F., Zukerman, I., Albrecht, D.W.: Assessing the impact of measurement uncertainty on user models in spatial domains. In: Proc. of the 17th Intl. Conf. on User Modeling, Adaptation, and Personalization (UMAP-09). (2009) 210–222
18. Berkovsky, S., Baldwin, T., Zukerman, I.: Aspect-based personalized text summarization. In: Proc. of the 5th Intl. Conf. on Adaptive Hypermedia and Adaptive Web-Based Systems (AH-08). (2008) 267–270
19. Fleck, M., Frid, M., Kindberg, T., O'Brien-Strain, E., Rajani, R., Spasojevic, M.: Rememberer: A tool for capturing museum visits. In: Proc. of the 4th Intl. Conf. on Ubiquitous Computing (Ubicomp-02). (2002) 379–385