Augmenting Experience in a Museum with a Location-based App for an Archaeological Site

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ABSTRACT
The experience of visiting a museum associated with an archaeological site located nearby can be augmented by a location-based app designed to explore the site. In this paper we describe the design of such an app for a relatively small archaeological site called Thetford Priory in England. Preliminary evaluation results of the app are reported.

Author Keywords
Archaeological site; Museum; Location-based app; Priory;

INTRODUCTION
In Europe, popular archaeological sites such as Pompeii in Italy, Delphi in Greece, and Stonehenge in the UK are widely visited and well-researched. In contrast, much less attention and research effort have been drawn to a number of relatively smaller but important archaeological sites, which could have elicited higher appreciation as cultural heritage and attracted a higher number of visitors. More important, they would have better been exploited for educational purposes [8]. The potential benefit of improving the popularity of these sites is that they can not only stimulate local economies but also encourage community-building and identity-building in both rural and urban areas. To realise such a potential, one obvious recommendation is to enhance the accessibility and appeal of these sites. Nonetheless, the challenge is that typically for small archaeological sites, the data and artefacts are not available or presented in forms that are meaningful to a general audience.

In recent decade we have witnessed major developments in the techniques of archaeological survey, the use of geographic information system (GIS), 3D scanning and modelling, and theoretical work on place and space have all expanded our understanding of how people, sites, artefacts and landscapes fit together. Astonishingly, the potential of exploiting the emerging technical and theoretical knowledge to augment visitors’ experience in an ancient landscape and environment of an archaeological site with their experience in a (typically co-located) museum dedicated to the site has been under-explored. This can be attributed to the fact that visitors are usually engaged with archaeological material on a site (with no artefacts) or in a museum (with no site). Developing mobile digital apps with the use of augmented reality (AR) to narrate histories vividly is regarded as a promising approach to enhance the meaningfulness, accessibility and enjoyability of visiting such sites, especially for non-specialist public audience. Furthermore, like all other mobile educational tools, such apps should be grounded in strong pedagogical frameworks to foster learning. In our project Representing Reformation (RR), we developed such a mobile app to explore a relatively small archaeological site known as Thetford Priory in England. In the following, we first briefly describe the motivation and historical background underpinning the project and the app. Then we depict the design of the app in detail, followed by a report on the preliminary evaluation results.

MOTIVATION & HISTORICAL BACKGROUND
Representing Reformation (RR)1 is an interdisciplinary science and heritage project exploring the multifaceted lives of the Howard Dukes of Norfolk – the most prominent noble family during the era of Reformation. The three-year project studied the Howard Tombs, two of which were originally planned to stand in Thetford Priory, Norfolk, England, but were moved to 60 km away in Framlingham after the priory’s dissolution by Henry VIII. The surviving remains of Thetford Priory include the lower walls of the church and cloister, along with the shell of the priors’ lodging and, reached by a pathway from the main site, an almost complete 14th century gatehouse. The ruin is of high educational value for the intriguing history of reformation dated 400 years ago. Specifically, the project RR aimed to deliver to the public an AR-based iOS app that contextualises the research findings in situ of the priory. The app can be used as an educational resource by schools to engage students and by the local museum “Ancient House of Thetford Life”2 to attract more visitors

Figure 1. Framlingham Parish Church (left) where the tombs were re-erected after they had been moved away from Thetford Priory (right) (photos source: Wikipedia).

1 http://representingreformation.net/
2 http://www.museums.norfolk.gov.uk/Visit_us/Ancient_House/index.htm
DESIGN OF THE MOBILE APP

The design and development of the app were driven by the meticulous collaborative efforts of a multidisciplinary team consisting of historians, archaeologists, museum experts, curators, game designers, human-computer interaction experts, pedagogical experts, and space research experts, who provided their expertise in 3D scanning and modelling. Technically, the app was implemented by a professional game company called Engima Interactive, which worked closely with the academic partners, who provided the content and resources.

Concepts

The mobile app enables geo-located AR of the artefacts found at the dissolved Thetford Priory site to tell stories around their relevance to the Howards and the findings of this project. There is a narrative to the physical exploration of the site clustered by themes on the funerals and tomb monuments of the Howard family with Second and Third Duke being most prominent character. Six Interest Points (A–F) are:

A. Dukes of Norfolk were powerful and important
B. Second Duke has a spectacular funeral at Thetford Priory
C. Second Duke’s tomb at Thetford Priory
D. Tombs were covered in meaningful things
E. Second Duke’s body was moved to Lambeth
F. Clues to the Third Duke’s tomb were found at the Priory

Using GPS location, the app can test whether the user is onsite or offsite. If onsite, the user can explore and access Interest Points by walking to them or by selecting the Points directly on the interactive map. If offsite, GPS navigation is disabled and users can access the Interest Points by selecting them directly on the map or scanning a QR code.

The main app navigation is represented as an illustrated map of the Thetford Priory site (Figure 2 with the five numbered orange dots).

The six Interest Points feature formatted text areas, imagery and video. Each content area is designed to display the supplied content in the most appropriate format. After visiting all six Interest Points, the “Conclusion Screen” will be presented to prompt users to find the location of the Third Duke’s tomb (NB: a historical puzzle is yet to be resolved). This screen is also used to provide key points the user has been given whilst using the app. If the user is onsite, the current location of the device will be displayed on the map. Users will be taken into the camera mode with the 3D render of the tomb being displayed over the device’s camera display. Users may rotate the image around the horizontally axis to position the tomb. If offsite, the user will have to identify the location of the tomb by selecting a point on the map; selecting will add a location marker onto the map, users may change this location by selecting another point. On selecting a location, the “I think the tomb was here...” button will be displayed. Clicking it will lead to the conclusion videos.

Figure 2: The main navigation map as an illustrated map of Thetford Priory

- Users may access help/further information. This area is displayed as an overlay on the map.
- The six Interest Points (red dots with “?” and the green dot with “?”) are displayed in their appropriate locations on the map.
- Selecting “Where to next …” suggests the next Interest Point to visit. The next Interest Point will flash prompting users to either walk to the Interest Point or select it directly on the map. “Where to next …” will lead users round the Priory on a predefined route. If the user has already visited the next pre-defined Interest Point, this will be skipped and the user will be prompted to visit the next point.
- Once a user has accessed or visited an Interest Point on the map, the point will be displayed as visited. Users may still access or revisit the point if required.
- Six different QR codes are generated to represent the six Interest Points on the map. On selecting to scan a QR code, the application will change to camera/scanning mode allowing users to scan QR codes. The scanning interface will also let users exit scanning mode. On successfully scanning a QR code, the appropriate Interest Point will highlight on the map prompting users to select the Interest Point.

Pedagogical Design

Mobile learning is a relatively new research area grounded in several related fields, including HCI and technology-enhanced learning (TEL) [6]. The emergence of location based technologies, countrywide Internet access and increasingly powerful multimedia capture and display has brought new opportunities to enhance learning in settings outside the classroom [1]. The app employs an inquiry-based design [2] that attempts to mimic the research process of the project. It can facilitate the realisation of our aim to encourage user-led investigation of the site while communicating some of the project’s findings and the type of work researchers in academic conduct. Specifically, we identify which media are required for different Interest Points (A – F), which learning styles to be served, and what learning outcomes to be expected (i.e. the Generic Learning Outcomes framework), and what relevance and personal meaning to be implied (see [3] for details).
Challenges and beta version prototype

As described above, the design of the app was first focused on the creation of the bespoke map (Figure 2) and then on integration of the GPS location finding functionality, which was used to inform on-site users where they were (the blue dot in Figure 3) and to trigger off the next Interest Point (the six points A-F explained above) by making it blink. When visitors were close to an Interest Point, pictures, expert videos and interactive 3D renders of some of the important objects found by archaeologists would become accessible (Figure 4).

The alpha version of the game prototypes was thoroughly tested in the field by the project’s partners. The main challenge was the precision of the GPS location finding in the archaeological site, which is relatively small to allow accurate estimation.

Figure 3. The mobile app used on-site in the Priory; the blue dot indicates the position of the user (the beta version. Source: Enigma Interactive³)

Figure 4. The mobile app showed the pictures, videos and other educational resources (source: Enigma Interactive³)

EVALUATION

Evaluation is an integral part of the developmental lifecycle of any interactive system, given the importance of interplay between user experience evaluation and system redesign [4]. As the app developed for the project RR was aimed to be a mobile learning tool, a specific evaluation framework should be employed, which is described subsequently.

Evaluation framework for mobile learning app

The evaluation strategy is informed by the six challenges of evaluating mobile learning [5, 6, 7] and the three-level framework proposed to addresses these challenges [7]. The challenges include: capturing and analysing learning in context and across contexts (school, local visitors, museum and priory site), measuring the processes and outcomes of mobile learning activities (learner-led inquiry), privacy issues (visitors using their own technology), the usability of the technology which is not personal (project supplied iPads), assessing informality of the learning setting (visitors & school field trips), and considering how well this fits into the wider organisational and socio-cultural context (the local museum, community and schools).

The three-level framework aiming to address these challenges is relevant to our mobile app [6]. The micro-level assesses usability issues; a meso-level examines the learning experience including the breakthroughs and breakdowns that occur in the process. Finally the macro-level considers how well the technology is integrated into the existing socio-cultural context, in this case the local museum, which facilitates visitors and educational field trips. This final level especially helps assess the impact of the application on the local community. A variety of mainly qualitative methods need to be used at different stages, including focus groups, semi-structured interviews and ethnographic observation of the application in use, Google analytics, user feedback reviews and questionnaires. Within the lifetime and resources of the project, we were only able to evaluate the micro-level - usability and user experience issues of the app.

Methods

As mentioned, the museum Ancient House of Thetford Life is linked to the archaeological site Thetford Priory. The museum is often visited by school children to learn about the British history of the Reformation era. It also attracts tourists, scholars, amateur historians and archaeologists and the like. Typically, after visiting the museum, visitors will walk to Thetford Priory. The evaluation of the app was incorporated into this typical journey. To facilitate data collection, we opted for a paper-based questionnaire, although for a handful of cases, upon the consent of the visitors, the “shadowing” technique [9] was employed. Nonetheless, to avoid overwhelming the visitors with a long questionnaire and to minimize the time they needed to spend in filling it out, especially for school trips, the questionnaire was made to be short and highly accessible (Figure 5).

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³http://www.enigma-interactive.co.uk/portfolio/index.cfm#thetford_priory_virtual_tour_assistant_mobile_app&show=featured
Ease of use: A 5-point textual scale was used to evaluate this aspect with ‘very easy’ being the leftmost anchor and ‘very difficult’ the rightmost anchor. In converting the five scale points into corresponding values 1 to 5, the average rating of ease-of-use is 2.06 (SD=0.95), implying that the participants found it rather easy to use the app.

Understandability: A 5-point textual scale was used to evaluate this aspect with ‘Yes’ being the leftmost anchor and ‘No’, the rightmost anchor. In converting the five scale points into corresponding values 1 to 5, the average rating of understandability is 1.91 (SD=1.04), implying that the participants found it parts of the app easy to understand.

Intention to use: The question was phrased as a hypothetical situation whether the participants intended to download the app if they had the iPad and the app was available. The majority (78%) of the participants responded “Yes”. This indicated quite a high acceptance rate.

Telling others: The majority (80%) of the participants responded that they would tell others about the app. Whether they would share the positive or negative experience with the others could not be inferred from their answers. Nonetheless, there was a highly statistically significant association between ‘intention to use’ and ‘telling others’ ($\chi^2 (2) = 10.41, \ p<0.01$). It suggests ‘telling others’ would likely be a kind of recommendation.

In summary, the app was positively perceived by the participants in terms of its enjoyability, ease of use, and understandability. The participants’ perceptions of good usability and positive user experience seemed having the impact on their intention to re-use the app and recommending it to others.

FUTURE WORK
The qualitative data are yet to be analysed. Results thereof will enable us to understand better what the participants liked or disliked about the app, thereby gaining insights into the redesign of the app. Furthermore, we can derive from the qualitative data what the participants have learnt from the app, allowing us to evaluate whether the pedagogical goal of using the app as an educational tool could be fulfilled.

There are several limitations to the study. First, we did not measure the participants’ experience in the museum to understand how it could influence their perception and use of the app in the site, especially the two experiences happened close to each other temporally as well as geographically. Second, the background information of the participants could have been richer, for instance, we could have asked about the participants’ interest in the subject matter. In cases where the participants were not interested in the historical topic concerned, their overall perception of the app might tend to be lower than those who were already
enthusiastic about the topic. The inherent drawbacks of using questionnaire approach are applicable in this study as well, for instance, quantitative data cannot tell us much about the actual use of the app or participants’ momentary experience. In the future work, a range of qualitative and quantitative methods should be used to triangulate the findings.

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REFERENCES


\(^4\) http://representingreformation.net/the-team/