Driving Engagement in Heritage Sites Using Personal Mobile Technology

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Abstract: The use of smartphone and tablet devices is now becoming more common in heritage and museum settings. The aim is often to further develop public engagement with tangible and intangible cultural heritage, explain and explore existing information about artefacts, sites and cultures and present new information in engaging and accessible ways to a range of audiences. Community archaeology groups are becoming alert to this trend and wish to engage with it too, particularly for 3D exploration of built archaeology and the artefacts associated with it. This poses a number of challenges that differ from those for artefacts and documents in museum settings alone. It also poses contextual challenges in relation to specific and highly engaged user groups like community archaeologists. This paper describes completed apps which have been designed to address some of these unique challenges of interpreting and exploring 3D digitally reconstructed historic buildings for community heritage groups.

Keywords: Community heritage, Public Engagement, Mobile Technology

1 Introduction

Public interest in archaeology has been increasing rapidly in the UK and both professional and community archaeologists find it useful to present their work to public audiences, often on site, to show how exciting finds can inform understanding of the communities and landscapes where we live. Presenting individual artefacts can help bring the past back to life but complex archaeological sites, with many artefacts, trenches, masonry, test pits and piles of earth can often make the ancient buildings in and around which they are found difficult to visualise for the non-expert. Furthermore recent finds are often processed and stored off-site and may not be available to the visitor so the connection between the artefact, the meaning behind where it was found and the process of archaeology can often be lost.

In order to help overcome these limitations, De Montfort University’s Digital Building Heritage Group has recently completed a UK Arts and Humanities Research Council (AHRC) funded research project (Grant Ref AHI.0132901) in collaboration with colleagues from the University of Nottingham and the University of Durham and two community heritage groups to produce two innovative new mobile device apps which allow finds and other information to be uploaded by users to 3D representations of archaeological and historical sites and explored in an intuitive way. The idea behind this was to give community heritage groups greater opportunities to interpret their own finds and present them in a way which would allow these groups to shape the stories about the archaeology they are involved with. In doing so the project and the applications are intended to address particular issues surrounding the use of mobile digital technologies for co-production of community heritage interpretation in community archaeology and to examine how the explanatory and interrogatory potential of mobile device software can be used to build community led interpretive paradigms for post excavation analysis, presentation and education in community archaeology projects. The problems of digital curation by community heritage groups has been previously recognised, with propositions to use the connected nature of the web to develop a sustainable method of data collation and organisation (Beel et al. 2015). This project adds a public facing aspect, allowing a community heritage group to not only organise and interpret their work, but to also present it in a meaningful and accessible way to the public.

Two specific archaeological projects in England were used for the purpose of this study; a Roman bathhouse in Northumberland and an historic urban fabric in Southwell, Nottinghamshire. For each of these two sites a community heritage group exists; these are associations of enthusiastic amateur historians and archaeologists who have worked hard to uncover much about their respective sites and have created and collected a rich tapestry of documentation about them. This community-produced media including content such as documents, images, videos and audio forms a persuasive body of constantly evolving evidence and knowledge. The core problem of this project was to produce a system that would allow these community heritage groups to collate and present their work and the content they had gathered to the world. The strength of the system would be in its ability to make the experience of interpretation social and collaborative, thereby leveraging the power of cross-media interaction (Giaccardi & Palen 2008).

Tablets were chosen as the delivery medium for this content for a number of reasons. Their growing market penetration means they are now familiar to a large proportion of the audience for this project. Tablets easily allow the presentation and manipulation of a range of media from text documents to three-dimensional models. The cross-media capacity of the application is an important step towards producing a solution that will both serve the public interest and the needs of the
2 The Community Heritage Groups

This project involved working with two UK community heritage groups: The Southwell Community Archaeology Group (SCAG) whose interests have focussed on a medieval area called the Burgage in the village of Southwell in Nottinghamshire which includes a 19th Century House of Correction (a form of prison), and the Architectural and Archaeological Society of Durham and Northumberland (Arc & Arc) whose interests in this project are focussed on a bathhouse in the Roman fort of Binsted. Both of these groups have been active for some considerable time in archaeological excavations on their respective sites as well as carrying out archival work and public engagement. Through these activities they have built up a wealth of expertise and documentation about their sites, with work shared amongst the groups’ members according to their individual interests and availability. What these groups often lack is a way to persistently organise and present the information they have gathered and present it efficiently to the world. Many groups like these have in the past turned to the Internet to produce web pages to act as repositories. Without specialist technical knowledge these websites are typically not well suited to the needs of those who wish to explore the archive. There is often little in the way of search or filtering capability. The medium itself does not lend itself well to the exploration of anything beyond text. The construction of such sites is often conducted by ‘hard-coding’ links and references to the various assets, missing the opportunity for the generation of an organised and systematic store that would be useful as a cataloguing mechanism for the community group in question.

These limitations often lead community heritage groups to look at tablet applications created for other, larger and national heritage institutions and to conclude that the technology could benefit their own causes if they could access it. However it is rare for a community heritage groups to have the skills and resources within its membership to develop a mobile device app from the ground up entirely without external assistance. Furthermore the alternative of bespoke app development by a commercial supplier can often place the technology out-with the funding and maintenance capabilities of these groups, in ways that may not be the case for larger organisations, museums and other heritage institutions. In addition to this there are also issues associated with the interpretation of the content. A museum has access to a wealth of expertise in order to arrive at an interpretation of an artefact and there is a large, multidisciplinary and very active international academic community publishing and discussing artefact interpretation. The degree to which community archaeology and heritage groups can / do / should access this body of opinion varies very widely and there are respected points of view which hold that local communities may be the most appropriate interpreters of their own heritage, irrespective of their degree of alignment with ‘experts’ from elsewhere. Whether or not one agrees with this viewpoint, there is a substantial and growing appetite amongst these community groups to be able to shape the narratives of the heritage assets with which they are involved. Moreover, there is growing recognition that participants in an exhibition can make as valid a contribution as professionals, with some noting how ‘even low-technology strategies for engagement can be successful in making visitors active contributors to heritage sites’ (Cioffi 2012: 58). The process of collating a shared digital story can also have positive effects beyond the direct, it can be seen as a ‘transformative
tool for personal, professional, organisational, and community development' in its own right (Freidus and Hlubinka 2002: 26). However, within these groups there are often conflicting views on meaning and interpretation, and indeed ownership or monopolisation of ideas, originality and points of view, just as there are in the academic world.

‘Communities are run through with divergent interests, anger, boredom, fear, happiness, loneliness, frustration, envy, wonder and a range of either motivating or disruptive energies. Added to this are thick seams of power that structure any given collection of people.’ (Waterton and Smith 2010: 8)

Just as in the academic world the key to overcoming these is transparency in evidence-based processes of evaluation. One of the key aspects of developing the paradigms underpinning the new apps for this project was to provide the means to allow individual group members not only to present evidence in the ways they saw as most appropriate but to be able to have discussion threads associated with the process of doing so that would provide a vehicle for working through alternative or divergent points of view. In this it was intended that the effect, for example, of a leadership position within the group, a position that may not be bestowed simply on the basis of their expertise in the area, did not overly colour the interpretation of evidence and that other voices in the group might be afforded equal weight by means of access to this on-line technology. We believe this approach can theoretically encompass multiple and divergent viewpoints as well as providing the opportunity for consensus should the group dynamic lead in that direction. Furthermore, by definition, a community heritage group is a constantly evolving entity albeit one unified by its members’ interests around a particular local site, area or subject. Just as the concept of community itself can be ‘renegotiated so that it fits the purpose for which it is being used’ (Crooke 2010: 17), so too can the composition and outlook of the community change over time. The Binchester and Southwell apps, as they have been developed by our team, are intended as a means of recording the views and interpretations formed by the groups’ members as these changes take place and form a vehicle for their potentially permanent record. Potentially this may help to ameliorate the fragmentation of recording and documentation that tends to occur in and by community heritage groups over time as membership and interests change.

3 The Proposition

This project therefore focussed on developing the means to allow community heritage groups not only to present but also to curate their research content in their own tablet application. In doing so it was hoped that a number of the issues faced by these groups could also be overcome. Key aims therefore were to:

• Develop a central repository for the group’s articles that doesn’t rely on any single individual.

It was decided that any system that was developed should have two primary components, the tablet application and a web-based administration tool through which the group members could control the content of the application. One route would have been to collect all the documents from the group and build an application based on that. However, if the group then wanted to add to the content at a later date they would need to bring in external expertise again to work directly on the source code of the app and go through the process of submitting an updated version to the app store. A web-based administration tool however gives the opportunity to have a portal that is accessible to anybody with a PC and an Internet connection. It also reduces the application source code updates to just those required to keep the app up to date with new developments in the technology of the tablet such as the operating system and the interface.

Apple’s iPad was selected as the target for the tablet application. This choice was based on a number of factors including:

• The popularity of the platform.

• Existing expertise within the academic team.

• The lack of divergence amongst targeted devices. An application for Android tablets for example would add extra complexity due to the wide range in screen size, resolution, and technical capabilities.

The total system therefore involved an iPad application that can communicate with a content management system based on a web server. This is a popular paradigm for content-based applications as it allows for updates to be pushed to application users without the need for a full-scale application update.

Community heritage groups collect and produce a wide range of media, so the system had to be capable of supporting that. As well as documentation relating to the site and the artefacts uncovered, the production of a public facing application is intended to lead the group to produce well-formed content designed to explain aspects of the history of the site to the public. This requires a system that can support videos and free-form text entry as well as images and scanned documents. In doing so the system also had to promote group discussion around individual documents to better inform debate and multi-vocal and / or consensual approaches to the interpretation of the site data and how this should be presented in the app.

It was important that the system be easy to repurpose for new groups. While the creation of the initial system for two specific community heritage groups in the first instance might require a large level of expertise in both application and web development, the effort necessary to reproduce the system for a new purpose should be minimal in order to reduce the cost for new groups to produce their own application.

It was also vital that the tablet application presents a meaningful way for the user to navigate the range of documents produced by the group. A simple list based approach would do little to convey the context of the information, nor for instance the important spatial relationships between the find locations
of archaeological artefacts for instance. A navigable three
dimensional model approach was therefore adopted whereby
the user would be able to explore the documents through
their location-based relationship with the site. This led to the
development of a novel 3D datapoint paradigm, whereby any
number of documents can be associated with one of a number
of datapoints located within the three-dimensional environ-
ment of the site. In many cases the group’s interest extends beyond
the limits of the primary site or building into the surrounding
environment. This is particularly the case with SCAG where
the House of Correction is part of the rich historical fabric of
the Burgage area of Southwell that covers an area of several
hectares with the village itself approximately a square kilome-
try in extent. The application therefore ideally also needed to have
a map view with a similar datapoint system operating over a
potentially unlimited geographically area.

The proposed method of communicating site and find details
to interested users is not new. Examples of iPad applications
that present users with a richly detailed 3D virtual tour have
been a valuable tool in enabling institutions to open themselves
up in some regard to the public. ‘A Window On The Past’ is a
prime example, developed by Liuna 3D Interactive (2014)
in collaboration with The University of Edinburgh, it presents
users with an interactive view of the university’s Old College
in such a way that they can interrogate the changes to the fabric
of the building through the course of history. Similarly, ‘The
Bank of England Virtual Tour’ app for iPad uses the same 3D
model paradigm along with a system of ‘data-points’ in order
to allow the user to explore the history of the Threadneedle Street
This project however builds on such ideas by using the 3D
virtual tour presentation as a malleable front-end, with content
supplied and controlled dynamically by the community group
themselves.

4 The Content Management System

The web-based Content Management System (CMS) was
developed on a standard php/mysql stack in order to allow it
to be straightforward to setup for new groups. Visual styling
and layout was utilised using the Bootstrap library in order
have a CMS that would adapt its layout based on screen size
and therefore aid accessibility. This means the CMS can be
used on devices from a full desktop PC down to a web-enabled
smartphone (see Figs. 3 and 4).

The CMS provides for secure access for registered group
members using a login system. It also uses the concept of
permission levels in order to give controlled access to a range of
members. In doing so the group are able to accept contributions
from members of the public, but maintain control over what
is actually presented in the application. This enables widened
participation in the curation and development of material, as
well as discussion around the interpretation of documents.

4.1 Defining Data Points

The CMS allows the group to define datapoints on both the
map and the 3D model in the app. The database stores the
location of each datapoint as a set of numerical data. In the case
of a map point, this is the latitude and longitude. In the case
of a model point this is the x, y, and z coordinates. Although
members of the group could use a tool such as Google Maps
to discover the latitude and longitude of a particular point on a
map this is far from ideal in terms of accessibility. The system
therefore presents a map view, using Google Maps, allows the
user to place a marker on the map at the required location, and
from this derives the latitude and longitude (see Fig. 5). Using
Google Maps presents an interface and interaction paradigm
that will be familiar to many allowing for quick navigation and
manipulation of the map.

Defining a point in the model is more problematic. The
coordinates used for each model are never externally visible,
leading to a trial and error method of discovery in order to
accurately place a datapoint. In order to overcome this the
Three.js JavaScript library was used to display a version of the
model used and allow the user to place a datapoint within it.
Rudimentary object slicing is achieved through manipulation
of the near plane of the projection. A set of three sliders allow
the user to accurately place the location of the datapoint (see
Fig. 6). While not ideal in terms of usability, this does function
as a much improved method of point localisation.

4.2 Managing Documents

A document can be added using a simple form. The information
recorded for each document includes:

• The name. This is the name that will appear in the list of
documents for a particular datapoint, alongside an icon
representing the type of document.

• The document type, selected from a list defined elsewhere
in the CMS.

• The datapoint the document is associated with.

• A short description, with options for simple formatting
including the ability to add a hyperlink to a web page.

The user must also acknowledge that they have the legal
authority to make the document publicly viewable.

The CMS then allows users to edit or delete a document,
subject to the permissions that have been setup. They must
also then choose to publish the document, again subject to
the permissions that have been established by the group. This
means that the CMS can act as a store for a range of document
beyond those displayed in the app. A single document therefore
can go through a process whereby its content or meaning is
discussed until a suitable interpretation has been arrived
at before publication in to the application. This process is
supported through the use of document-specific discussion
threads. In a similar fashion to an online forum, a discussion
thread is associated with each document allowing for a dialogue
to emerge that can be traced. This discussion is purely internal,
and therefore not a part of what is published to the application.

5 The iPad Application

The application has two main views: Model View, and Map
View. The Model View presents a three-dimensional model of
the building in question in such a way that the user can scale,
rotate, pan and slice it (see Fig. 7).
The concept of 'slicing' or more accurately sectioning the model (see Fig. 8) is we believe novel within mobile device heritage apps at this time. It is a particularly effective method of exploration as it allows the user to cut through the model along any of the three x, y or z axis and reveal not only the interior of rooms but also the interiors of walls, floor, roofs and the ground. It is controlled by a quarter-circle thumb slider on the right of the screen combined with the rotating axis selector on the left which are both placed in these positions to allow for ease of operation when holding the iPad in both hands in a landscape orientation. This ability means that data points can be placed within structures such as walls and floors (as well as elsewhere) and not just on their surfaces and can be revealed as the section is slid through the model. In the z (up and down) axis the analogy in doing so is remarkably similar to the process of digging the site, with the structure and finds emerging in an intuitive way that visually parallels the actual process of archaeological excavation.

The user can update the contents of the application using the button in the top-left of the interface. This opens a tab that informs them of the size of the download from where they can choose to either download the update or close the tab. The update facility has been added as an all or nothing facility. Rather than allow the user to manage the update on a document-by-document basis it was decided to simply update all data in the app. This leads to a simpler method of interaction for the user. It is recognised that the user may often take their iPad to the actual location of the building or site where there may be no Internet connection. To overcome this there is the facility to update everything in the application beforehand when they do have an Internet connection so that they have a complete set of all the media that is available in the system when on-site.

The Map View presents datapoints in a similar way, allowing the user to tap a datapoint to display a list of all documents associated with it (see Fig. 9). It uses Apple’s default Map View therefore presenting a map that the user will likely know how to interact with already. It also displays their current location on the map should they be exploring on-site which allows the user to navigate in real-time between the datapoints. There are
obvious uses here for archaeological geo-tagging and other forms of in-life game-play using this feature that offer potential social interactivity benefits to the use of the apps.

6 Conclusion

The development of this system was highly collaborative, involving archaeologists, local historians, architects, computer programmers, graphic artists and 3D digital modellers. The ongoing success of this community-based technology project such as this relies upon the sustainable engagement of the community groups which in part comes from the sense of ownership they take from being involved in the conception and running of the project (Balestrini et al., 2014). Initial meetings with both community heritage groups led to the establishment of a robust set of requirements that were largely adhered to during the development of the apps. The groups tested progress in the development of both the CMS and the iPad Application in order to produce a system that was fit for purpose. The end result is a system that allows the members of a community heritage group to curate a set of documents for presentation to the public through an engaging iPad application that is truly multimedia. In addition to this two key new concepts have been developed in these apps which make them different from other data-based archaeology apps that are available and which make a significant advance in the functionality and usability of apps on archaeological sites for heritage interpretation.

1. The first is the ability for registered users to upload finds data to an on-line database. This is done over the Internet using the CMS in a normal web-browser. Information to upload can be text, images, video and audio. This finds data can be geo-located in three dimensions to precise points on the archaeological site by the user during the upload. When the user then looks at the app on their iPad, they will see new datapoints on the 3D and 2D views of the site and by pressing an update button on the app screen, the new finds data will be uploaded from the server and become clickable hot-spots on the datapoints which will show the finds data.

2. The second innovation in these apps is the use of 3D reconstructions of the buildings associated with the finds and the way they are presented. The hot-spots appear in three dimensions in the buildings. In order to reveal ones inside structures or in walls and floors or underground there is a 'section slider' which allows the user to see inside the buildings and their walls and floors. In this way it really is like digging down and through the building to reveal the locations of finds so that you can click on them.
Fig. 6. The slider bar method of defining the 3D (x,y,z) location of data points, shown in this case within the 3D reconstruction of the Binchester Roman bath house app. This method is common to both apps that have been developed.

Fig. 7. The 3D reconstructed digital model of the Binchester Roman bathhouse building within the app interface. The reconstruction is deliberately elementary so as to omit detail that might change substantially on later interpretation and is intended merely as a 3D visual armature or placeholder on which to place the data points and to allow visitors on site to develop a mental picture of the full overall form the building from the foundation and wall remains. The stars on the data points indicate that they have new data that has been uploaded to them.
Fig. 8. The section function of the apps make exploration of the interiors of and the fabric of the buildings and sites intuitive and allows data points to be revealed that lie within the fabric of structures.

Fig. 9. The map view using Google Maps allows users to place datapoints at positions that are not restricted to the small area represented in the 3D digital reconstruction model of the Roman Bathhouse alone.
Finally, these are prototype apps developed as part of ongoing research to bring better, self-directed heritage interpretation to wider audiences and archaeology enthusiasts as well as professionals. The apps are free to download from Apple's App Store and at present are available for Apple's iPad only. There is scope for further development here. The system can be further refined on the basis of usage metrics collected by analytics tools embedded in both the CMS and the application. Further consultation with both of the community heritage groups involved in this project and other users of the apps can yield fresh insights into the effectiveness of this technology in the wider context of community heritage, archaeology and public engagement.

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