Digitally Glueing the Past: Multimodal Interaction for Un-Stewarded Historical and Archaeological Sites

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ABSTRACT

We investigate multimodal Mixed Reality Environments (MREs) to support and engage visitors at un-stewarded historical sites - those with no staff or visitor facilities. Through three studies we identified issues surrounding interaction with different content in the system, and the need to promote exploration beyond any physical remains that exist. We outline the implications of these and our future investigation plans.

1. INTRODUCTION

The Antonine Wall (www.antoninewall.org), running from the west to east coast of Scotland, represents the most northern settlement of the Roman Empire in Britain. In 2008 it was designated as a UNESCO (www.unesco.org) world heritage site. This places it on the same level of international historical importance as the Sydney Opera House and Great Wall of China. Yet, unlike those sites, few obvious visual remains exist. Those that do are spread over several hundred kilometres of rural countryside. As such, although parts of the wall are accessible to the public, they are unstaffed and have no other facilities such as visitor centres. Archaeological finds have been moved off-site to museums many miles away. We term such places as un-stewarded archaeological sites. A concrete example is Bar Hill fort [3]. 100m long on each side, the fort contains a Principia (administration block), bathhouse, workshop and several barrack buildings. However, only the Principia and bathhouse have visible remains. As there are no staff, only a few signs illustrate the importance of the site. Many archaeological artefacts have been discovered at the fort, but these are in store or on display in museums in the surrounding area.

Working with the Hunterian Museum and Historic Scotland, we have been investigating how visits to un-stewarded sites can be made more engaging and informative. Our goal is to better understand the challenges of supporting visitors and develop multimodal techniques (using gesture, speech and non-speech audio) for their effective digital augmentation. This is distinct from the mostly visual work at stewarded sites such as reported by Costabile *et al.* [2].

2. VIRTUAL EXCAVATOR

Virtual Excavator is a Mixed-Reality Environment (MRE) [1] that provides an augmented reality auditory environment overlaid on a physical archaeological site via an application running on an iPhone. As a visitor walks around the site, the on-board sensors (GPS, gyroscope and magnetometer) monitor location and update a 3D auditory space around the user (as well as a visual archaeological map of the area). This means that sounds can be fixed to physical locations in the environment. We incorporated two different forms of geo-located sound.

Actors represent personas of people who lived and worked at the site. These play a similar role to re-enactors at open-air museums, explaining to the user their lives and the area the user is in. We created personas in conjunction with archaeologists and had them recorded by professional actors. The recordings are activated as the user enters a small 10m radius surrounding the actor. As the user moves around (perhaps looking at the area the actor is talking about) the perceived distance and direction of the actor will change. If the user walks sufficiently far away the actor is dismissed and removed from the space.

The other auditory form, effects, was designed to create an auditory "buzz" of the activities that existed in the area. The effects were also designed to "pull" the user towards interesting parts of the sites (e.g. the sound of hammering indicating the direction of the blacksmith shop). The auditory display allows multiple overlapping cues that can be given definite auditory boundaries beyond which individual sounds cannot be heard.

In addition to the auditory feedback in the system, we also incorporated artefacts that had been found at the site. This presents a good way to link a visit to the site to a future visit to a museum where the artefact is held. As a user approaches a 10m radius from the location of an artefact, the device vibrates. The user can then shake the device to simulate something of the excavation process. Once excavated, the artefact is added to a list in the user interface, and its location logged on the map for future reference.

3. EVALUATION

So far we have carried out three field studies of Virtual Excavator. In each of these studies we have focused on varying the physical environment - from "patchy" physical remains (Study 1) to no visual surface remains (Study 2 and 3), content and users to gain an in-depth understanding when used on the un-stewarded sites previously described. In total 48 participants aged 8-14 took part in the evaluations.

In all studies participants were video recorded with post experiment semi-structured interviews. Application interaction data and movement data were logged on each device.

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A framework analysis was employed on these data and key areas on the exploration of un-stewarded sites identified.

3.1 Interaction with Finds and Actors

In all three studies participants interacted with both finds and actors. Participants strongly preferred the finds over the actors, these being frequently rated as the "best part" of the experiment. Whilst collecting finds was an important part of their popularity, *"We did* (double back). *Because we needed to find the Roman coin"*, the physical act of excavation was also cited as a reason: *"I liked how you had to shake it to dig up the artefact"*. Participants were also quickly able to understand that the sound effects might indicate the location of an artefact: *"I got a sort of kitchen noise and then I found two artefacts when I went towards it. So I think it was when you were getting near to something."*. In addition, the sense of needing to walk to uncover an artefact also extended to participants creating strategies focusing in and around the buildings to improve their chances in locating finds: *"I kind of tried to get into the little rooms* (buildings in the fort) *to see if there's anything there"*. Actors, on the other hand, were much less interacted with. In Study 1 participants only listened to the actor's speech for 31 seconds on average (speech length was 45-50 seconds) before dismissing it. This was even shorter in Study 2, with on average only 8 seconds of the actor speech being presented. In study 3 we substantially shortened the actor speech, and whilst this lead to an improvement and an increase in popularity, the overriding dominance of one type of information (the finds) largely drowned out that of the actors. Future work is required to improve the usefulness of the actors and make them more integral to the overall experience.

3.2 Dominance of Physical Archaeology

In Study 1, which centred on Bar Hill fort described earlier, although participants could explore the entire area of the fort, they constrained their explorations to the areas surrounding the principia. This is only one of two areas where visual remains exist. This is surprising given the popularity of finds (see Section 3.1), that finds could only be discovered when the user was in the physical vicinity, and that users knew finds were located outwith the principia. In Studies 2 and 3, where no physical remains existed, participants explored the entire area. In Study 2 for example, which was on a smaller physical site, participants covered a much greater area of 2187m^2 vs. 1240m^2 for Study 1.

Whilst the lack of physical archaeological remains freed users to walk over a larger area, there was still evidence that the physical environment guided exploration of the fort. In Study 2 and 3 participants discussed how they used the map on the device, an indication of the location of subsurface remains, as well as other physical features of the environment, to systematically explore the site: *"I didn't take my eyes off the screen. I just kept looking at the screen all the time. So that I could see where I was in the map and if I was close to any of the buildings"*. One participant described his exploration of the fort: *"Yes. Well, I started off here* (refers to map) *then I went down to the lake here* (refers to map), *I don't know why, but then I went along..."*. The lake, which was really a large puddle, guided users' exploration rather than constraining them, as occurred with the archaeological remains in Study 1.

This behaviour is an important distinction from prior work on MREs [1]. The "patchy" nature of remains at un-stewarded sites demands that users be supported to explore, and thus understand, the entire site; even those parts where no remains exist. Our approach of using environmental sound as a means to encourage this was only partly successful; helping users locate finds but not pulling them to areas with no visual remains, such as the barracks or cooking areas. Stronger encouragement, for example redesigned actors that could physically move around the site and encourage visitors to walk with them to areas without visual remains, could be employed to overcome this issue.

4. DISCUSSION

Our work with Virtual Excavator has uncovered unique aspects of applying MREs to un-stewarded sites, notably the issues surrounding the patchy nature of physical remains and how this affects user exploration. Further work is required to understand the issues of physical remains and their effects, and techniques need to be developed to pull users from the physical remains and encourage exploration of the whole site.

Virtual Excavator has shown that engaging, informative and enjoyable experiences can be provided through digital augmentation of un-stewarded sites. In addition, these experiences can be provided through the use of mobile devices that most visitors already have, eschewing the need for costly equipment and facilities to be provided to support users. Digital augmentation offers the possibility to make these un-stewarded sites more useful and attractive, increasing visitor numbers which in time may make dedicated staff and facilities more practical. Virtual Excavator also allows us to link together disparate physical locations into a coherent story. Inserting the current display location of the finds that users virtually excavate would encourage visitors to visit and see the artefacts that they "found". In cases such as the Antonine Wall, digital augmentation provides a "glue" to connect the different physical elements together into a coherent experience. In doing so, more enjoyable and engaging visits can be provided to archaeological and historical sites that currently do not support the expenditure of dedicated staff or visitor facilities.

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6. REFERENCES

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