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Learning from the Experts: Enabling and Studying DIY Development of Location-based Visitor Experiences

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ABSTRACT

In this paper we show how – with the aid of enabling technology – creative Location Based Experiences can be developed for visitors by non-technical professionals from the cultural heritage sector. We look at how these "Place Experts" approach and adopt web technologies to create and publish experiences including the roles they take on, the processes they adopt, and the way they appropriate the technology. We describe our short and long-term research engagements with the cultural heritage sector over the last three years and introduce Wander Anywhere, the website developed to enable this research. We find that place experts typically follow a four stage process in their engagement with location-based experiences, moving from comprehension to translation, development and finally approval. We suggest implications for the processes and technologies that might be employed by others seeking to support a similar type of engagement.

Author Keywords

Location; location based experience; mobile; cultural heritage; authoring; user studies

ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

INTRODUCTION

Over the past three years we have engaged in collaborative research on location-based technologies with partner organisations and professionals from the cultural heritage sector. We enabled this research by developing a website that allowed our partners to create, test and deploy Location Based Experiences (LBEs) for visitors. Our aim was to learn from the way they approached and adopted this technology.

Since Cyberguide [27] almost two decades ago, the HCI community has developed a significant body of work exploring the opportunities for LBEs in tourism, heritage and culture, or more generally in relation to *visiting*, e.g. [12, 1, 4, 19]. Our

own previous research in this area – and that of our close colleagues – has involved playing a pivotal technical role in deployments of location-specific experiences. Acting in this capacity has revealed technical implications for location-based technologies, and enabled us to explore new applications of LBEs. However, we recognise technical challenges that limit exploration of LBEs by communities such as the cultural heritage sector.

Reflecting on the current state of mobile technologies particularly the ubiquity of "smart" mobile devices, the emergence of HTML5 with benefits such as offline, and geolocation support and the increasing accessibility of mobile wireless broadband [29], there is now an opportunity for the research community to create *enabling technologies* that allow the managers, experts and volunteers at tourist sites "place experts" to author web content and deliver it to the location-aware web-browsers in many of their visitors' mobile devices. We introduce the culture and heritage sector in this paper and note that place experts often have experience of designing outdoor visitor activities, but have yet to adopt mobile technologies as a means of delivering visitor offerings, perceiving certain barriers to doing so.

To explore the potential for enabling technologies, we developed a technical artefact – a website – that allows non-technical users to attempt "do-it-yourself" (DIY) authoring, deployment and iteration of LBEs. This was achieved by leveraging ubiquitous web software, resulting in interfaces that are *mundane* and allowing users (both authors and visitors) to interact using *their own* computers and mobiles. We position the website as a novel technical artefact for the cultural heritage community. In contrast to previous work that sought to validate support tools in the confines of research sessions, e.g. [17, 26, 15, 32], we have worked with the cultural heritage sector to support and study their use of Wander Anywhere "in the wild". Specifically, we sought to support place experts in the different roles they take during the process of understanding, developing and releasing LBEs. Our relationship with partners has taken a variety of forms, ranging from prototyping workshops to full iterative development processes resulting in real-world public releases.

In this paper we present the context and motivation for our research in detail. We then introduce our strategy for engagement with the cultural heritage sector, and the technical artefact – Wander Anywhere – that was developed to support this engagement. We then present our key findings, organised as

themes, from the collaborative activities with our partners. Taking a retrospective view of this long-term process of collaborative research, we also present the typical four stage process that the place experts went through, along with the implications for processes and technologies that we believe can facilitate effective engagement by place experts with LBEs.

CONTEXT

The research described in this paper was triggered by our previous engagements as technical researchers with practicing artists and the cultural heritage sector. We have been involved in several streams of research exploring new roles for mobile technologies in location-specific performance, art and heritage offerings. We have worked closely with "place experts", i.e. experts on the locations for which LBEs are designed, such as local historians [11, 34], local government authorities [20], local businesses [3] and local residents [35]. These efforts have resulted in a range of real-world deployments of novel technological artefacts, including location-specific games (e.g.[6, 5, 20]) and guides (e.g. [35, 3, 11, 34]).

In each of these cases, researchers have arguably played as much the role of technical developer as researcher. Developing a novel technology is a means to an end; in most cases the research aim was to explore the applications *enabled by* the technology although in doing so, implications for the technology are revealed. Enabling a novel experience involving remote and in situ users revealed the value of self-reported positioning over GPS in urban environments [6]. The experience of touring such experiences demonstrated how designers of LBEs might benefit from tools that revealed "seams" in wireless infrastructures, leveraging them as design features [5]. Co-designing visual markers with non-technical experts demonstrated the need to be able to explain – in non-technical terms – the computer vision rules at play [28]. Because the underpinning technologies here are novel, a significant amount of technical skill is required in bringing them together in a timely fashion to allow the research to happen. Indeed, toolkits such as EQUIP2 [21], DART [18], and Dey et al.'s Context Toolkit [16], have been built to make this process more rapid.

Reflecting on Cyberguide, we question whether we have moved on. On the one hand, we have explored a range of new applications of location-based technologies; on the other, the technologies are still bespoke, sophisticated and hardly ubiquitous, thus perpetuating the siloing of LBE expertise (as noted in [33]) to research institutes and software labs. Instead, we believe that we can gain valuable new insights by sharing responsibility for more aspects of the development and deployment process with our partners. We have made small steps here before. In [3], we considered how technologies can enable place experts to orchestrate LBEs; in [31] we see how place experts adapt and use tools developed by researchers to refine an LBE. However, by handing over the entire process – by enabling place experts to develop LBEs from concept to public release – new use cases and examples may also proliferate, providing a fruitful area for research. Hull et al. pose the analogy of the democratisation of web publishing, whereby easy-to-use, freely available tools allow almost anyone to create web-sites, spurring on our collective understanding of what it is possible to produce [23]. Weise et al. argue that place experts (including local residents) *should* be more involved in the development of LBEs and ubiquitous infrastructure that they are built on, as a means of maintaining control over their localities [39].

Enabling the Development of LBEs

Researchers have already sought to contribute technologies to encourage the development and evaluation of LBEs by *non-technical experts*. iCAP simplifies the conditional programming of context-based experiences (including LBEs) through a visual interface [15]. Mediascapes [23], StoryPlace.Me [7] and LoMAK [17] (as well as commercial systems such as 7scenes[1]) allow authors to visually geo-fence trigger locations and link these to locative media. Topiary applies a visual story-board metaphor to the design of LBEs [26].

These tools have demonstrated variable success. Bentley et al. describe how older users were able to use the Serendipitous Family Stories authoring tool with ease to carry out simple authoring tasks [8]. However, Hull et al. describe the difficulties experienced by authors in coming to terms with programming concepts that spilled over into the Mediascapes authoring tools [23], while Li et al.'s user study shows how the complexity of LBEs can be difficult for authors to model in their simple desktop GUI [26]. Hull et al. describe such systems as "programming in the small" [23], highlighting the emphasis these systems place on being at the desk during the authoring process. Researchers studying such systems often note mismatches between the intentions of the LBE authors and their experience in the real world [38, 14]. Place experts using LoMAK found it difficult to predict what mobile users might be able to see while walking [17], while the effect of GPS "errors" surprised authors using Mediascapes [23]. In general, the effects of the outdoors – including lighting and ambient noise – can make the mobile experience of media radically different from the desktop [2], and difficult to evaluate using traditional techniques [10].

To address this, tools that allow place experts to author and evaluate LBEs "in the wild" have also emerged. Urban Tapestries provided locals with a mobile app to create content "on location" and contribute this to a public collection of locative media [25]; this project highlighted the importance of being on location as a means of understanding how locative media might be interpreted in situ. The Tidy City project provides both mobile and web-based authoring tools that allow an author to walk an environment to produce a rough draft of their LBE then refine the design at a desktop [40]. This notion of refinement is also adopted by CASTOR [32].

These examples show that it is possible to hand over the process of authoring an initial design of an LBE to non-technical users. By learning new easy-to-use tools, place experts are also able to experience how their design translates to the real world. However, these tools do not support place experts in progressing an LBE beyond the initial prototype stage. In

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[1]http://7scenes.com (originally accessed 10 February 2015)

fact, we have seen little evidence of research that demonstrates how place experts can be actively included in *iterating*, *deploying* or in running *user tests* of their designs. The recent PLACE framework [9] considers LBE design as an involved iterative process, encouraging designers to move from concept development to evaluating their designs with real end-users, in real social configurations, with their own devices. This framework appears to be aimed at researchers, rather than place experts. We question whether place experts might take on responsibility for more roles in this longer term process of LBE development, thus allowing us to focus on learning from their efforts "in the wild".

The Cultural Heritage Sector as a User Community
The cultural heritage sector, i.e. organisations and individuals who work to preserve monuments, natural environments, historical records, art and cultural practices, represents an obvious potential user community for technologies that support the creation of LBEs. Over the past three years, we have partnered with a range of place experts from cultural heritage organisations around the UK.

In late 2012 – at the start of this research – we convened a meeting of 14 heritage site managers from the UK. To judge the expectations of this community, we presented a range of the location-specific experiences developed by the research community. A representative response from a manager of an independent local heritage site suggests a gulf in expectation: *"these are inspiring – really fantastic – but way out of our league! We'd settle for some gentle steps, you know, translating the outdoor activities we currently offer to mobile phones and see how this opens new doors"*.

We focused on understanding why the attendees were not taking the "gentle steps" towards exploring mobile location-based experiences. Out of the resulting discussion, the following factors were suggested as *three key barriers*: cost of outsourcing development, risk of paying for an unsuitable product, and lack of familiarity with the developer community. More generally, these barriers arise from a need to hand-over control for the development of mobile experiences to external agents. The attendees were not used to doing this during the development of other sorts of visitor experience. This quote from the regional director of one of the UK's largest conservation charities conveys the group's consensus: *"we happily leave our experts to invent really wonderful activities for our visitors, but with mobile we have to hand over ideas to the digitals (design agencies). We can't just try and work it out for ourselves"*.

RESEARCH METHODOLOGY
Shaped by the meeting in 2012, our research methodology involved the long term engagement of our user community – cultural heritage organisations and professionals – via the release of *Wander Anywhere*, a website that allows users to author, deploy and review the use of LBEs[2]. For our user community, this was a novel technological artefact, and we refer to the concept of *technology probes* to explain our aims in developing it. A primary aim with technology probes is

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[2]See http://wanderanywhere.com/

#	Where?	When?	Participants
1	Rural parkland	2013; 1 day	8 local conservation experts and site staff
2	Urban	2014; 3 days	15 local social historians and tourist guides
3	Urban parkland	2014; 2 days	16 cultural heritage professionals and site staff

Table 1. Wander Anywhere make-and-do workshops

to get them out, into "the wild", to allow patterns of use and disruptions to emerge: they are "not a prototype, but a tool to help determine which kinds of technologies would be interesting to design in the future" [24]. Technology probes are deployed into real situations with real users [37]. As a research tool, we expect probes to cause changes in the behaviour of the user community, but also for the user community to adapt and extend the tools to suit their needs.

At one end of a spectrum, probes might be a component of "breaching experiments" [13], provoking unexpected new practices in entirely new contexts of use. Our aims were less radical. In our case, long-term processes exist within the cultural heritage sector for developing and evaluating visitor activities; we deployed Wander Anywhere as tool to explore how these existing practices, the roles of experts, and the expectations of mobile technologies might change. We do not see this as a breaching experiment; instead we have carried out both *short* and relatively *long-term* research interventions, to observe the impact of the artifact on the *expectations of the community* and the *development practices of the community* respectively. We describe these two styles of research engagement in more detail below.

Short engagements: "make-and-do" workshops
During our research we have conducted three "make-and-do" workshops, bringing together place experts from our target community for up to three days (depending on availability of the experts) of rapid LBE creation and iteration at an outdoor location with interesting heritage. We invite participants from a variety of organisations in our target community to attend (see Table 1). Attendees almost exclusively claim no skills in developing mobile experiences: two of the guides who attended workshop #2 had experimented with native apps to create walking tours, and one attendee to workshop #3 had experience of creating content for audio-guide apps.

Each workshop was a "bring your own device" event. Researchers led the first hour of the workshop, helping attendees split into small groups of 2-4 people, introducing the Wander Anywhere website and the venue, but then supporting the groups in experimenting (authoring at their laptop, and testing on their mobile outdoors) for rest of the workshop. Each group were given a goal of producing an LBE, and encouraged to iterate their design at least once. During refreshment breaks, researchers held rapid face-to-face feedback sessions (transcribed in field-logs); post-workshop evaluation surveys were also collected from attendees for more general feedback.

#	Where?	When?	What?	End-users
1	Urban parkland	2012; 3 months	Concept to public tests	21 experts
2	Rural parkland	2012-3; 1 year	Concept to 6-week public release	98 visitors
3	Urban parkland	2013; 9 months	Concept to 1-month public release	57 visitors
4	Urban and rural	2014; 6 months	Concept to public tests	51 visitors
5	Urban	2014; 2 months	Concept to public tests	18 visitors
6	Urban parkland	2015; 1 month	Concept to public tests	19 experts

Table 2. Long-term Wander Anywhere design engagements

Long-term engagements: participatory design

Beyond prototypes and disposable test experiences, the website has been used by partners in the cultural heritage sector to implement 6 LBEs. We have conducted these engagements in the spirit of participatory design [36]: introducing our partners to Wander Anywhere, observing their use of the artefact, and – based on direct feedback and observations – making necessary refinements to Wander Anywhere's design to solve basic usability, performance and operational issues. Table 2 presents an overview of the design engagements. These processes all started with a stage of concept design, but ended at different stages, some going only so far as tests with other place experts (engagements #1,6), some to the point of visitor tests (#4-5), and some to "general release" (#2-3).

The nature of the experiences varied, including a tour of a country estate "in the footsteps" of an artist who painted scenes of estate life (engagement #2), locative art exhibitions (engagement #1 and #3), history tours (engagement #4-5) and an arts-oriented treasure hunt (engagement #6). The figures cited in the final column of Table 2 refer to the final stage of each engagement, and do not include earlier organised or ad-hoc tests. In addition, these figures do not report "false starts", i.e. users who started to use the mobile client but stopped before finding any locative media.

Researchers carried out short semi-structured interviews with partners during the early stages of development, attended all organised tests (the final stages of engagements #1 and #4-6) and were present for regular full days of the public releases (in engagements #2-3). At organised tests, researchers carried out rapid feedback sessions, keeping field-logs, while during public releases researchers conducted semi-structured interviews with consenting visitors, and a small number of walk-alongs (recording using video-capture glasses).

WANDER ANYWHERE

As an enabling technology for research with our target community we developed a website that serves as a single point for *authoring* LBEs, *accessing* them (either via a desktop computer or via a location-aware mobile device), and *reviewing* logs of visitor's experiences. The emphasis in designing the website has been on ensuring that it is simple and – where possible – familiar, to encourage its use without our intervention.

WordPress as authoring tool

The Wander Anywhere website[3] is based on the open source *WordPress* content-management system (CMS), extended to allow authors to create both standard blog posts and geo-tagged blog posts via a *standard web browser* (see Figure 1).
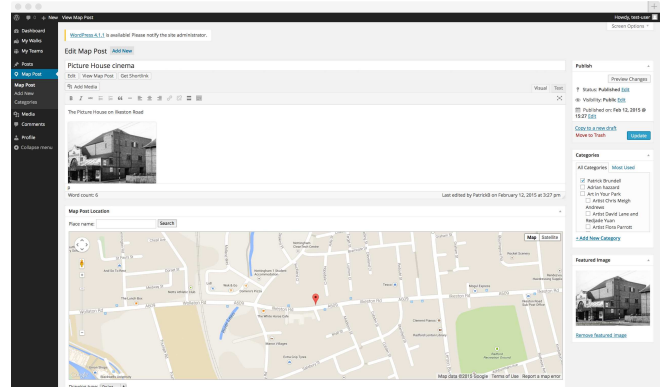

Figure 1. Wander Anywhere authoring with geotagging functionality

By building on the most widely used web CMS [4] we ensure that some potential authors are *already familiar* with the authoring interface. In our research engagements with 101 place experts who have used the website in the last three years, just over 20% had previously used their own or someone else's WordPress CMS to create web content. For those without previous experience, the UI bore resemblance to other CMSes they had used (e.g. "to update our website at work"), or at worst allowed familiar operations such as the ability to copy-and-paste content into the visual WYSIWYG editor, and apply formatting in a manner similar to familiar word processing software. The website allows authors to review the content they have created, either in a familiar "blog" view or on a map.

HTML5 Mobile Client

Away from the desk, authors and end-users can experience the locative web content by pointing their own mobile devices at the same website and using the HTML5 mobile-friendly version. This mobile web client allows mobile users first to choose an LBE from a list of all those created through Wander Anywhere. Authors had the opportunity to advertise URLs that linked directly to specific LBEs: we discuss emergent strategies for using these URLs later in the paper. The mobile site then helps the user navigate to the nearest piece of geo-tagged content, offering a choice of three styles of navigation. Users could use a map, viewing their current location and that of the nearest piece. Alternatively users could request a compass bearing and distance to the nearest piece. Finally, users could view a "solar compass" that showed the direction of the

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[3]http://wanderanywhere.com/
[4]http://w3techs.com/technologies/overview/content_management/all/ (as of 10 February 2015)

nearest piece in relation to the position of the sun (Figure 2, left). When the user reaches a trigger location, the mobile site reveals the content tagged with that location (Figure 2, right).
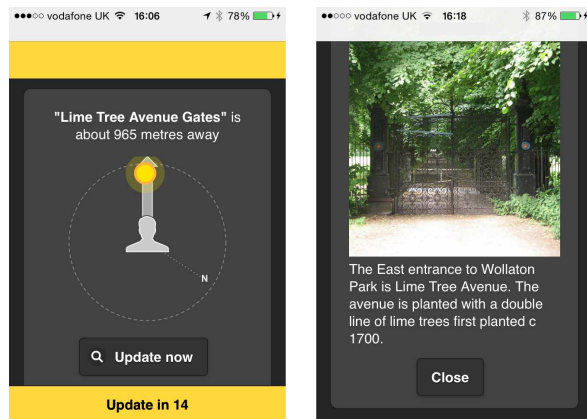

Figure 2. Wander Anywhere navigation between pieces of content

Data Logging and Review

Taking inspiration from work such as [30, 5] that argued the benefits of revealing the work of infrastructure in LBEs, we added a simple analytic component to the website. While a visitor hunts for locative content using the mobile website, their location is logged, typically every 10 seconds, in order to update the directions presented by the mobile website. These traces are accessible in anonymised form to authors who may view them plotted on a map in relation to the locative media they have created (Figure 3).

Figure 3. Traces from mobile clients, plotted over locative media

FINDINGS FROM "THE WILD"

Having conducted our extended period of research with the cultural heritage sector, we are now in a position to draw out *recurring themes* from our observations. These themes have emerged from analyses of qualitative data: researcher field-logs, recorded interviews and surveys collected from participants after design workshops. After significant collections of data (e.g. after workshops, and after periods of observation during design engagements), members of the research team coded data. One researcher coded all data over the three years, while others contributed during shorter periods. In each case, researchers began with the set of codes used in

the previous coding session, introducing new codes as necessary, comparing codes and removing synonyms where possible. Our focus over the course of the coding sessions has been to identify codes that recurred across workshops and design engagements. We present these recurring findings as themes. As data collection was often opportunistic and coding was conducted over a long period, the results are *illustrative*, rather than rigorously representative. We use quotes from the data to illustrate themes, attributing these to specific partners and research activities where appropriate.

Author expectations: what can we make?

Our place experts initial expectations came from their past experience of creating visitor offerings.

Our partners tended to quickly pick up the concept of the Wander Anywhere mobile client – *"you only had to try it once to get that it's like a sat-nav for web pages" [workshop #1]* – and there was a general expectation to create a *trail* of content to discover and follow. Initial attempts were sometimes described confirmational (e.g. Figure 4) or indeed *boring*: *"I'm not sure why I put a photo of the location at the location – it seemed like the obvious thing to try" [workshop #1]*, but served the purpose of confirming that authors knew what they were doing. Partners in our design engagements enjoyed this familiar model: *"we deal in linear routes; it helps us manage visitors and keep surprises to a minimum" [author, engagement #4]*. On the other hand, some authors complained that Wander Anywhere tended to produce a particular type of experience: *"whatever you make, it ends up feeling similar. Now that I know what I'm doing, I can't really push the model beyond the 'walk, find something, walk, find something else' thing ..." [author, engagement #3]*

Figure 4. Attendee testing an unsurprising LBE during workshop #3

However, due to the way that the mobile client dynamically chooses shortest paths through content, when authors positioned a number of map posts close together unexpected and variable sequences of content emerged. Some workshop participants found this element of serendipity entertaining: *"I had an order in my head – obviously I didn't get how the tech worked – but I've ended up with a surprising schizophrenic narrative that sort of works" [workshop #2]*. One author realised it as a design capability: *"I wish I'd noticed it sooner. I didn't know it worked this way until I had a chat with a visitor*

who went completely the wrong way" [author, engagement #3]. Others saw this as a risk: "two of us walked the same walk and got different triggers. We laughed, but it would be no good if we gave it out to real visitors" [workshop #3].

Some authors noted that the concept of hunting for content evoked a game-like feel: "it's different to a guide book because you can't just flick to a page, and you don't know what you're heading towards; it's definitely more like a game" [workshop #2]. Others designed their experience *as a game*: "ours is a story, but in the style of an adventure game: we want users to make choices outside by the way they move. We want them to feel like they could 'go the wrong way' and end up in a sticky situation" [workshop #3].

It should be noted that some also drew inspiration from the other LBEs posted on the Wander Anywhere website. This was particularly evident during the workshops, where authors had to quickly develop a concept – "it kick-started our brainstorm, but we had to be careful not to copy their ideas" [workshop #2] – but less so in the design engagements where the partners placed an emphasis on creating their own distinctive LBE: "I had fun looking at this other stuff, but I've got my own clear idea" [author, engagement #2].

The ever-present issue of mobile navigation
All three of the navigation styles offered by the mobile client were used extensively by the workshop participants and users during deployments. Observation of the design engagements suggests that users tend to choose the map view initially, trying other styles only after ensuring that they understood the map style. Visitors suggested that maps were familiar ways of navigating on mobiles: "it's an obvious choice isn't it? I use Google Maps almost everyday to drive, and I use it when I go somewhere unfamiliar" [visitor, engagement #2]. Having become familiar with one style, users tended to stick to that preferred option, although some visitors switched for fun: "I tried the sun and compass modes for a laugh; I walked around in circles for a while – don't judge me – but did feel like I'd really earned it when I found something!" [visitor, engagement #6] In two of the design engagements, our partners were keen for visitors to avoid the map, feeling that it *harmed* the experience: "I want paths to emerge *in response to the environment*, not for visitors to just plot a route using the map" [author, engagement #3], "we're all about the outdoors – we teach orienteering and ecology – I want visitors to learn something about using a compass through the experience" [author, engagement #2]. In fact, in engagement #5 the authors preferred that visitors avoided looking at the mobiles between trigger areas, as they were led on a predefined walk by an experienced tour guide (Figure 5).

Benefits and problems of "bring your own"
Over the three years we have noted the spread of smart mobile devices. In workshop #1 and engagement #1 we had to lend suitable mobile phones to users regularly; since then we have been surprised by the range of devices that users have brought to workshops, or used as visitors during engagements. Cost was a benefit cited by our engagement partners: "it's perfect

Figure 5. Predefined walk by expert tour guide, engagement #5

that visitors bring their own tech – we couldn't countenance buying in handsets to give out" [author, engagement #3]

Despite many of these devices being compatible with the mobile website, the sheer variety has revealed issues. One such issue emerged during engagement #2. The LBE designed in this engagement was extensive: users who attempted to find all content typically spent over an hour walking the location. A significant minority of these users brought tablets, and found it difficult to carry and use them for this length of time: "I really enjoyed finding the early things, but my arms got really tired. I should've used a phone I suppose, but I thought it would be better on a tablet" [visitor, engagement #2].

In workshops #2-3 we rarely lent devices and participants tended to prefer forming groups to share each other's devices instead. During engagements, partners had no devices to lend, and so our understanding of the visitors' devices is more anecdotal, but staff managing engagement #2 suggested that "I think it would be a mistake to give out mobiles to visitors who didn't have them: what if something went wrong out in the estate? They wouldn't know how to fix some random phone they've been given" [author, engagement #2]. It is worth noting that all workshop participants that had suitable smart devices also had a mobile contract with data allowance, and were happy to use this. Partners were keen to warn visitors in public tests and releases about mobile data usage to avoid issues later on: "I'm cautious about anything that might come back and bite us, since it'll be me that has to deal with it. Our signage reminds visitors that this is the same as any other web browsing" [author, engagement #2].

Understanding mobile infrastructure
The variability and effect of mobile infrastructures (data and positioning) were revealed to both authors and participants during our research. Authors quickly learnt about the effect of mobile data network reception on the reliability of content loading, e.g. "I didn't realise it varied so much, but I can stick a YouTube video at this end of the lake and it'll work, and the same video at the other end and there's no chance" [author, engagement #4]. Testing their LBEs in groups revealed the variation between network providers: "I came back feeling depressed – I knew [my provider] was crap, but [another author] in my team could walk along next to me and get all the images perfectly, while I had to keep refreshing the page to get it to do anything!" [workshop #2].

Figure 6. Video watching as another waits for buffering, workshop #3

Authors learnt about the impact of the physical environment on GPS both by testing their own LBEs and querying the analytical visualisations provided by Wander Anywhere. In urban locations, authors noted obvious black-spots: *"this lot laugh at me, but I didn't know GPS didn't work underground – trying to put content in the tunnel is a no-go then ..."* [workshop #2] In rural areas, the visualisations of visitors' traces revealed some surprises for authors: *"we had some complaints about some particular pieces – it's only after we had a few traces on here that it becomes really obvious that the trees are causing an issue. Who knew?" [author, engagement #3]* Authors learnt to anticipate and respond to environmental features: *"we* need *the walkers to go down that street – it's where the view is – but GPS is going to be bad. The buildings are very tall. I made the trigger area really large, so they'll definitely hit it somewhere" [author, engagement #5].*

In design engagements our partners also noted apparent effects of weather on both positioning and data. Staff managing engagement #2 recalled, *"when it's really hot and humid – when we get the most visitors walking out into the park – the phones seem to play up more than usual. Oddly, fresher days seem to give more reliability. I'm probably reading into it too much ..."*. Other researchers have also noted the effects of the weather on mobile service [22].

Emerging local practice
Our design engagements revealed the way that place experts applied and adapted existing practices for the development of visitor activities. In particular we noted a common strategy for testing, with authors first testing a prototype themselves, then including colleagues, then members of the public. Only if a design passed these stages did the place experts deem it safe for "public release".

Testing often had to fit around day-to-day work on locations. Initially, authors in engagement #2 attempted to conduct *orchestrated* test sessions with colleagues, helping them to use their mobiles to find Wander Anywhere and then the LBE, and noting issues as the testers "spoke aloud" their user experience. As we attempted to observe these sessions we found that they became increasingly *ad-hoc*, as described by this member of staff: *"because we're spread around the Estate it's actually damn nigh impossible to know when we might be able to get a group together. We can't just shuffle our schedules around – we're all busy. Sometimes it just happens though, and it's been so useful to say: just get your phone out and try this ..." [author, engagement #2].* The

ease with which the content could be edited supported this ad-hoc approach, with staff making immediate changes post-test: *"I don't carry a pad and pen around with me all the time, so if I didn't go and fix something straight away I'd probably forget!" [author, engagement #2].* In engagements #2 and #3, initial authors saw internal tests as a way to enthuse colleagues: *"it's always the way – everyone's a skeptic until you actually show them something, then they suddenly want a piece of the action" [author, engagement #6].*

Public testing was a familiar activity for some of our partners, who were used to evaluating new public engagement activities. After leading tests in engagement #4, one author explained, *"we always have to demonstrate the value of new activities to justify ourselves to our funders – we have a structure for evaluations that we know well, and it has worked fine for these walks"*. This was echoed by partners in engagement #3: *"I know what [a funder] wants to hear, so I'm used to asking particular questions during tests"*. Indeed, some of our partners had user groups on hand to test new activities, and drew on these groups during the design engagements: *"I can mobilise representative subjects quickly – they've tried enough of our ideas to be critical, but at the same time get where we're trying to go and be constructive" [author, engagement #2].*

Making first contact happen
We saw evidence that getting access to an LBE for the first time via the mobile website could prove difficult for some users. This was less true in the workshops, where the researchers demonstrated how to use the mobile website at the start of the session. In the long-term design engagements, our partners were responsible for making their LBEs accessible to visitors – it became evident that this was not trivial in early tests. Location staff in engagement #2 conducted facilitated trials with "friendly" groups of visitors (i.e. staff family and friends), and helped each tester launch the browser on their mobile, enter the toolkit's URL and find the correct LBE in the mobile client. During these trials, staff noted that the simple step of navigating to a URL in the mobile web-browser, which they had learnt quickly and carried out hundreds of times since, was problematic for many visitors. One frustrated staff facilitator related his findings to us: *"we didn't really think about it, but people tend to Google for web-pages – they aren't used to typing in an address. If what they're looking for isn't top of the search results, they get stuck. 'Type in a URL' just doesn't compute" [author, engagement #2].* In other engagements, it was noted that if visitors did attempt to find a specific LBE via the list in the mobile client, they might be tempted to try one of the others instead: *"it's distracting – we reckon some people are getting lost before they even find our content" [author, engagement #3].*

In response to these difficulties, our partners were quick to experiment with ways of avoiding or simplifying the process of accessing an LBE. In engagements #2 and #4-6, the URL for specific LBEs were encoded in QR codes and tested (e.g. Figure 7).

In engagement #2, visitor centre staff noted that *"visitors were intrigued [by the QR code] – even if they didn't have*

Figure 7. QR code as an access point for the LBE, engagement #2

a barcode app, they sort of understood what the purpose was and wanted to find out what it did. We saw parents encouraging kids to get an app to scan it" [author, engagement #2], and seemed pleased that *"it's point-and-shoot – really easy – as long as they've got the right app"* [author, engagement #2]. Authors also explored alternative schemes that were more in keeping with their location. There were some concerns voiced by staff and visitors about the aesthetics of QR codes, and their impact on the local environment; one visitor to the location stated that *"it sticks out like a sore thumb here next to these lovely old buildings; I'd rather it wasn't here on full view"* [visitor, engagement #2]. In workshop #2 and engagement #6 authors tested *Aestheticodes* [28] as an scheme that provides creative freedom and the opportunity to make the code "invisible": *"QR codes are plain ugly – and don't give any hint at what they do – the sign should reflect what you're about to set in motion"* [workshop #2].

Spreading the LBE

Building on the earlier aesthetic concerns, staff in engagement #2 refused to consider putting out advertising for the experience into the parkland. Instead, opportunities to hide adverts for the experience and use other visitors as the vector were explored, inspired by some of the staff's knowledge of *geocaching*. Caches of small paper tokens were placed in the parkland at two locations that were used in the LBE. The LBE drew visitors to these hidden caches, where they were encouraged to leave a thought in the paper logbook in the cache, take a ream of tokens, and pass them on to other visitors. The tokens included the URL for Wander Anywhere and – depending on the design – the QR code for the LBE. The caches grew as visitors decided to leave more than simply a thought, depositing objects they had found on their walk as well as geocaching coins. One interviewed visitor commented on the effect of the cache: *"I didn't know there was such a thing as geocaching, but it's a great idea. I really want other people to go and find that collection of thoughts, particularly now I've added to it. It turns these stickers [the tokens] into more than just a piece of stealth promotion. More like I'm inviting someone in ..."* [visitor, engagement #2]

In engagement #3, our observations of mobile users revealed a number of casual interactions occurring between visitors out on location. Mobile users' interactions with their devices drew attention and sometimes conversation: *"I think they wondered why I was laughing at my phone and trying to climb into the bushes. I had to explain that I was trying*

to find hidden stuff, just to prove I wasn't crazy" [visitor, engagement #3]. This conversation sometimes led to sharing: *"I think people don't want to be left out. I could see their kids trying to see what I was looking it, so I told their parents how to find the website"* [visitor, engagement #3].

Digital footprints and design heuristics

Wander Anywhere's analytic visualisation was a source of interest during workshops and design engagements. In workshops, participants liked the graphical way in which the workings of mobile technology were revealed. They could clearly see the accuracy of GPS positioning and its effect on their ability to discover map posts, and make inferences about the way in which other participants had moved during explorations: *"even if I didn't know where the paths were in the park, I could sketch them based on these dots"* [workshop #1]. Authors noted how points in the visualisation clustered at the start of experiences: *"the shopping centre is so obvious – all these points are from us all standing around waiting for our phones to kick in"* [workshop #2]. One attendee at workshop #3 - an expert employed at a country estate popular with visitors - stated *"one of our biggest issues is trying to spread visitors more evenly around the estate, particularly out into the park: we design activities to change the flow of visitors"*. The same participant suggested that understanding the flow of visitors would be highly valuable when redeploying assets such as signage and cafes, or targeting conservation efforts.

Authors went as far as to suggest that these "digital footprints" might also make a compelling visitor experience. After prompting by early workshop participants, we developed a live visualisation of traces for workshop #3: this provoked discussion around its *"game-like feel"*. A similar visualisation was developed during engagement #2, and displayed as an projected installation in the location's visitor centre. Staff commented that, *"the projection seemed to get more attention than the experience itself! It definitely encouraged some visitors to try out the [LBE], I think because it showed them where they should go"*. Place experts also suggested that the footprints might make good *souvenirs*: *"I think we could sell a personalised map based on their data – visitors could see what they missed, and come back again to do the other bits of a site"* [author, engagement #6].

Authors also used the visualisation to develop heuristics for design, based on their various tests. Authors in engagements #2-4 began to consider how patterns in the traces reflected visitor behaviour. Speed was considered important: fast travel might indicate confident movement towards the next map post, while closely spaced dots on the visualisation indicated dwell, which in turn might suggest either interest in a location or confusion over directions. In engagement #4, an author demonstrated how these insights were used: *"we look hard at the clusters to see what's going on. If there's not content there then something might need addressing ..."*. During workshop #3 the notion of a "boredom threshold" was coined. This reflected comments from workshop #2: *"if we space content too far apart you get a mixture of boredom and frustration – you feel like you're commuting between loca-*

tions. We ended up filling in long distances with 'filler' content just to maintain attention".

Appropriation and creativity

Authors made unexpected uses of the capabilities of Wander Anywhere, pushing the system beyond the simple multimedia model introduced at the start of workshops. Authors quickly began to experiment with embedded media and widgets to overcome the lack of options for interactivity in the basic Wander Anywhere editor. In workshops #2-3, participants embedded Twitter streams in geotagged posts, along with instructions for users to tweet a message with a particular hashtag. This allowed mobile users to leave messages for other users to find, on location. Authors experimented with widgets from other popular social media and user-generated content services, looking for suitable widgets to allow photos to be uploaded and viewed: *"it's fun to explore all the options – most of them don't quite work in the mobile site – they seem to break the layout or be a bit clunky, but it shows you what is possible" [workshop #2].* The link with social media was seen as key: *"Twitter and Facebook are our lifeline right now – they're how we get to younger visitors, so getting integration with them into this experience is really beneficial" [author, engagement #4].*

Figure 8. Using wireless speakers and relief sketches, engagement #5

Our partners also experimented with ways of using other tools alongside the mobile device. In engagement #2, a set of real compasses and paper maps were provided for visitors to use with the mobile website as a means of making the compass bearing style of navigation more appealing: *"on one hand it makes the compass points easier for people who don't really do bearings; on the other it gives everyone in a family something to hold and contribute – we had a lot of fun!" [visitor, engagement #2]* In engagement #5, a core aim of the design was to cater for visitors with limited vision: the authors catered for this by providing Bluetooth speakers so that groups could all hear locative audio content, and paper 3D reliefs of the locative images so that visitors could "feel" the images displayed by the mobiles (see Figure 8).

DISCUSSION AND IMPLICATIONS

Through three workshops and six longer-term design relationships we have observed how place experts have approached the creation of LBEs. We have observed four common stages in this process of enquiry, and over the three years we have refined our own processes and tools to support this engagement by place experts with LBEs. Through these commons stages of equiry we draw together our observations and resulting implications for both processes and technologies (labelled P*n* and T*n*, respectively).

1. Comprehension

In this first stage place experts with no experience of developing location-based mobile experiences sought to answer questions such as *"what is it?"*, *"what can it do?"* and *"should I spend more time learning how to use it?"*. The "make-and-do" workshops facilitated this initial enquiry, allowing place experts to develop a basic understanding of the nature of LBEs and how they can be created. This initial stage typically involved creating mobile equivalents of familiar visiting experiences, e.g. guided information walks.

P1: Prefer facilitated discovery over information delivery for initial comprehension. We found that guided hands-on "trial-and-error", especially on a site where place experts will encounter design obstacles, gives place experts rapid insights into LBE design and technology limitations, and also embeds the habit of real-world testing into their emerging design practice. Exploration alongside other place experts – including peer critique – accelerates this process of discovery.

T1: Provide a familiar and immediate interface for initial use. At this stage it is important that the tools minimise barriers to initial use. Ideally place experts should be able to use their own computers and mobiles. It should be as fast as possible to get started. The interface should use familiar metaphors and interaction, e.g. WYSIWYG editing. And "one click" publishing should allow place experts to deploy a first design within minutes.

2. Translation

At the end of a workshop place experts typically progressed to questions such as *"will this work just as well when I try it at home?"* and *"can I really do this on my own?"*. The workshops were conducted on sites that could be considered as generic tourist locations but differed significantly from the specific sites managed by the attendees, so that place experts now had to *translate* their initial discoveries and understanding to their own "place". This typically involved a period of self-led experimentation with little or no involvement from colleagues or visitors, which had to be fitted around existing demands on their time.

P2: Provide clear and actionable prompts for follow-up activities. Simple structured tasks such as rebuilding experiences developed in workshops on their own site enable place experts to begin to relate their knowledge of their own site to their growing understanding of LBEs. Often place experts will also need continued support in this process.

T2: Support exploratory prototyping anywhere, anytime. Place experts should be able to immediately use the knowledge and tools from the first stage on their own site, whenever they have time. Being able to refer back to designs created in stage one is also important for continuity and learning.

3. Development

Place experts often moved on to ask questions such as *"what will be useful for our site?"*, *"who needs to be involved in development?"* and *"which of our visitors are able and willing to use the LBE?"*. This reflected a general shift from self-directed experimentation towards more rigorous testing and refinement of their LBEs. This ranged from ad-hoc testing and demonstration to other stakeholders within the place experts' organisations to more formal tests with visitors.

P3: Encourage the progression from exploration to rigour. Place experts and their organisations often have existing protocols for trialling visitor activities. But researchers can also contribute valuable insights into conducting field trials with technology, as well as the common challenges and opportunities of LBEs.

T3: Support collaborative development. It is important that the original place expert can involve other people in the development process. They are becoming experienced LBE authors, but colleagues and other stakeholders will almost always have valuable or even essential contributions to make.

T4: Support trials and evaluation. To develop a good LBE it is important to do regular tests and trials, including with potential end-users (visitors). Authoring and development tools should make it easy to run trials, and also to review and analyse the results of those trials, e.g. through suitable visualisations. These tools may also explicitly reveal predictable effects – GPS shadows, etc. – that were, in stages 1-2, left for place experts to discover.

T5: Support integration with the visiting ecosystem. The LBE in development is almost never the only activity at that site. The tools should allow for the LBE to be tailored and integrated with the other apps, technologies and experiences that visitors will engage with on the same site and visit.

4. Approval and Public Release

Finally the place expert – or their organisation – may ask *"is this good enough for public release?"*. An established site will not launch and promote a LBE to a large proportion of its visitors unless it is confident that it will work reliably, reflect positively on the site or organisation and not undermine the experience of those or other visitors. This reflects a significant transition from prototype to "production".

P4: Respect the approval processes. In many organisations there will be established processes for managing this kind of transition. Many of the considerations are non-technical, for example cost and projected use. There are also a range of non-functional characteristics of the LBE that will often be pre-requisites for making this transition, in particular reliability, availability, branding, security and in some cases the ability to monetise the experience.

T6: Support the transition from development to product. If the system that was used to design the LBE is also to deliver the public experience then it will need to satisfy various specific non-functional requirements as noted above. Alternatively a different system or technology may be used for the public version of the experience, in which case the tools used in the earlier stages should allow assets and ideally the complete design to be exported to the production system.

Reflecting on Wander Anywhere, we have seen the website develop to effectively support stages one to three of this process. The choice to use web for authoring and experience, and in particular the well-known WordPress CMS, creates a familiar and immediate first encounter (T1), allowing place experts to use their own laptops and mobiles to create, deploy and test their first LBE within 30 minutes. By being able to take their devices back to their own sites and continue to access the same web tools, place experts are then able to translate their initial learning (T2). We saw sustained periods of development supported by: the ability for place experts to add *new* authors and collaborators (T3), the data logging and review component (T4), and the ability to integrate other web services, e.g. through social media widgets (T5).

Many attendees of our workshops sought simply to understand LBE technologies, and a full public release was never a goal: *"it'll be years before we can actually get to this, but we now know what "it" is" [workshop #2]*. The place experts in the two long term engagements (#2-3) that *did* reach public release had relaxed requirements about the branding of the final experience, content protection or monetisation. But other place experts did not consider Wander Anywhere to be suitable as the delivery platform for a production LBE, for example because it did not support extensive customisation of the look-and-feel of the mobile client, and the communal nature of the site means that it is difficult to make LBE content or design private from other place experts. Some place experts also disliked the user experience provided by a mobile web client: *"it's a great prototype [...] but it's not got the polish we need" [author, engagement #4]*. However, Wander Anywhere does provide both an API that can serve locative media to 3rd-party clients as well as export content for use in a more suitable production client (T6).

CONCLUSION

Working with place experts through a series of workshops and longer-term engagements we have found that their exploration of LBEs typically progresses through four stages: comprehension, translation, development and approval for public release, each of which has distinct implications for the processes and technologies that support it. We conjecture that a similar pattern may be seen with other ubicomp technologies. We have found that Wander Anywhere, partly as a result of its use of web technologies, has effectively supported the first three of these stages. However it has limitations as a solution for the fourth stage, public release, and a transition to other technologies and platforms may be more appropriate at this stage. Our next steps in development are to improve support for the development stage, in particular providing additional insight in the data logging and review component, e.g. highlighting common paths (T4).

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