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# Evocative Computing – Creating Meaningful Lasting Experiences in Connecting with the Past

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**Abstract.** We present an approach – evocative computing – that demonstrates how ‘at hand’ technologies can be ‘picked up’ and used by people to create meaningful and lasting experiences, through connecting and interacting with the past. The approach is instantiated here through a suite of interactive technologies configured for an indoor-outdoor setting that enables groups to explore, discover and research the history and background of a public cemetery. We report on a two-part study where different groups visited the cemetery and interacted with the digital tools and resources. During their activities serendipitous uses of the technology led to connections being made between personal memories and ongoing activities. Furthermore, these experiences were found to be long-lasting; a follow-up study, one year later, showed them to be highly memorable, and in some cases leading participants to take up new directions in their work. We discuss the value of evocative computing for enriching user experiences and engagement with heritage practices.

**Keywords:** pervasive computing, user experience, heritage practice, memories, evocative computing

## 1 Introduction

The lives of people from different times and places are preserved through cultural heritage sites, and as stories about them are passed on through generations, they provide us with a sense of humankind’s history. We may, for example, consider our own eating habits and food preparation methods when we visit the kitchens of an old cas-

tle, and see the layout, the pots and pans and the recipes that were used all those years ago. Ubiquitous computing technologies are increasingly being used to augment such artifacts to help us delve deeper when exploring historical sites and museums. Museums often provide interactive exhibitions, digital information points and mobile guides, making it possible for people to hear or read about relevant information relating to the artifacts that are close by. There are however some concerns about the introduction of such technological tools, not only about their design and usability, but also about how they impact on the visitor experience as a whole. The social qualities of visits to such places can be impaired when using isolating single user tools, and it remains a challenge as to how to create experiences that are engaging and that draw visitors in – so as to enhance the visitor experience and to enable people to relate this to their own personal histories [9].

A number of researchers have designed visitor experiences with the aim of creating more engaging, participative approaches for people to explore history and the arts. These include setting up a game-playing environment in a museum [26]; providing tools where people can record their memories in outdoor settings so that they can be listened to by other visitors [21] and setting up special rooms and interactive objects for reflection and sharing opinions [9]. However, cultural heritage is not just found in museums but also in our physical environment and in the stories we tell around them; the buildings we live in, the monuments, installations and statues erected in memory of people who have died, and the objects we use as we go about our daily life.

Our research is concerned with taking this one step further: how can we design and use technologies to support the processes of reflecting and sharing of memories for historical sites, situated outdoors (such as cemeteries, roman ruins, castles)? In particular, we are interested in how a historical place can be brought alive, and histories revealed through discovering and learning more about the lives of the people who lived or are buried there.

User involvement can make the visit itself more engaging, but what happens after the visit? How can we go beyond creating environments where people can record their own perspectives, opinions and memories, to creating environments that enable people to make new associations between their own lives and the present visitor experience in meaningful and enriching ways? Can these both be felt in the moment as well as reflected upon later? If so, how can we design technologies to engender such moments, where new insights, emotional reactions, flashes of understanding and connections are made [3] – without knowing in advance what form they might take? Our approach: *evocative computing*, is an attempt to enable serendipitous enrichment and reflection in life: providing opportunities for personal memories to surface in ongoing activities that will result in them being forged and cemented in deep and long lasting ways.

To this end, we developed an assortment of distributed digital technologies - designed and configured for people to be able to readily pick up and put down, use momentarily or 'stumble upon' in the context of their activities. These were deployed in the setting of an old cemetery by a number of different community groups uncovering the stories of the people that lay buried there. Multiple entry points were provided [cf 17, 22] so that individuals, in the context of a group activity, could make connections

between their personal memories and in-the-moment experiences. Through these, an assortment of digital images, records, maps, sounds were ‘at hand’, that could be accessed, annotated, added to, and searched for, at different times and in different places. The resources, devices or displays were not owned by or given responsibility by any one person but were meant to be shared and used casually, and to be used to delve deeper into the details of a story.

We describe the technology set-up that was initially piloted in a small cemetery, and then used in events at a large cemetery. Then, we present a user study of it being used by various community groups. A follow-up interview study, a year later, was conducted to determine how they had engaged with it and what they remembered from using it. The findings are discussed in terms of what people recall about their experiences, how they reflect upon them, and what aspects of the technology they particularly remember.

## 2 Background

The use of computing technologies in museums has largely supported the solitary visitor, rather than the museum visit as a social occasion with people discussing and sharing their thoughts as they go around the exhibits. A popular aid is the mobile guide; visitors are given small handheld devices that are listened to like a mobile phone, sometimes with little screens. Whilst providing additional information for the individual experience they do not lend themselves to sharing, in the way written labels and other exhibit displays, like posters do. The audio guides typically provide background information about a painting or other artefact that is being viewed. They tend to be curated and hence do not support multiple perspectives, including that of the visitor [16].

**Social Interactions** The social aspect of visiting exhibitions has been explored in response to the realization that most visits to museums and other cultural places are in families or small groups [26]. Woodruffe [27] designed an audio guide that could be shared, through an ‘eavesdropping’ mechanism, meaning that people could both listen to information, but also have conversations with each other and overhear other people’s conversations. Social interaction is also the focus of the Kurio museum guide system, in which visitors were assigned the role of time travelers as part of a game, working as a team to collect various forms of information from the museum environment in order to repair their time traveller’s map [26]. Kurio, a hybrid system, comprised a set of tangible computing devices, a PDA, and a tabletop display. Participants enjoyed working collaboratively and also enjoyed ‘doing things’ by pointing, gesturing, reading and listening with the various devices. Mcloughlin [21] developed a system to augment an open-air folk museum which aimed to recreate life from late 19<sup>th</sup> century through a series of dwellings that people could walk up to and look inside. Visitors could meet the ‘inhabitants’ of these dwellings, who explained how they went about their household chores or carry out other jobs. An empirical study showed that when exploring the park, visitors tended to reminisce about their childhood and about memories of the past from parents and grandparents. The researchers, therefore, developed a sys-

tem that centered around this theme of memories: visitors were able to listen to memories of historical figures and record their own in response, and through the collection of tangible tokens could listen to memories that had been left behind by other visitors [21]. Another angle on interaction between visitors was developed by Ciolfi in ‘Retracing the Past’ [9]. Here, a deliberate effort was made to keep upfront information about the objects to a minimum, in order to encourage discovery and exploration by visitors. As part of this exhibition, both a ‘Study Room’ and a ‘Room of Opinion’ were set up; visitors engaged through a number of interactive objects, including an ‘Interactive Desk’, to study the provenance of the objects, and an ‘Interactive Radio’ to listen to experiences of other visitors and record their own. All these approaches involve the active engagement of visitors, where they have the possibility to share memories, conversations, personal thoughts and ideas. This was found to lead to high levels of engagement with the artefacts on display.

The above are examples of technologies that have been specifically embedded in a cultural setting to encourage reflection and exploration, and involve artefacts or exhibits that are in some way special but not normally part of the visitor’s day-to-day life. Here, we are concerned with how technology can be set up to encourage experiencing history in evocative ways that will be long lasting.

**Lasting memories** Turkle [25] writes about the process of reflecting with objects that are very much part of our normal life, but that are somehow ‘evocative’ to people. Such evocative objects often relate to ‘thresholds’, both widely experienced historical events (e.g., war), and important transitions and developments in our own lives. They often command a sense of provenance, being evocative because they are understood in relation to particular places and events. Through these characteristics, our experience of an evocative object often subverts the sense of distance between us, and another time and place. This creates further emotional and reflective responses that are important for personal development.

Another way of characterizing the relationship between the user experience and technology is in terms of enchantment. This refers to “a sense of something not yet understood in a way that leaves us feeling disrupted yet alive, attentive, and curious” [8]. Bennet [6] suggests it refers to how people get ‘caught up and carried away’, heightening their perception and attention, but often through a process of disorientation. McCarthy et al. [20] propose that new technologies can be designed to enchant, and enable people “to wonder and to the wonder of life”. Anecdotal examples include encountering the Apple G4 Powerbook for the first time. They argue that the more depth there is when making discoveries the longer the enchantment will last. Ross et al. [23] discuss how enchantment can be viewed in terms of meaningful mediation and the tensions surrounding them; for example, wearing an iPod changes the way we experience the world and the way we interact with people.

**Journeys and Discovery** The goal of our research is to design technology as an enabler to evoke experiences, triggering and cementing new associations with a place being visited. Ubiquitous computing offers much scope for facilitating and connecting past and present user experiences, through enabling people to ‘dive in and step out’ [c.f. 1], reflecting on their discoveries. Benford et al. [4] have developed the framework of trajectories to characterize user experiences as journeys through hybrid struc-

tures, interrupted by transitions, and in which the interactivity and collaboration are orchestrated over space and time, involving multiple roles and interfaces [4, 5]. The orchestration of what the players have to do is pre-planned to instill certain forms of pleasure, learning and surprise. A question this raises is how much of the experience should be engineered for and how much should be left as ambiguous or uncertain. Should the user experience be scripted to a high level to ensure that participants are guaranteed a certain kind of experience [5] or should it be left more open-ended, so that surprising and serendipitous experiences can result [7]? The benefit of the former is that participants are reassured and know what they have to do, where to go and the objectives of the game. However, they may not discover much for or about themselves that makes them marvel or enables them to make deep and long-lasting connections. To enable people to take the initiative and discover new connections requires thinking about how to design for chance and serendipity [12]. This, in turn, involves more than simply designing for fortunate accidents to happen. For example, Andre et al. [2] argue that it is important to design not just for the discovery of new information but also the insights drawn from those discoveries. These can be gleaned through discoveries that are not only serendipitous but also through the movement between different types of experiences, some of which are systematically reasoned about and others driven by curiosity [24].

**Evocative Computing** The focus of our research is how to design for more open-ended experiences, encouraging people to discover and make connections, themselves. Although they may be more disorienting and confusing than scripted ones, we argue they can lead to deeper and more memorable experiences. In particular, we are interested in enabling people to make connections with their own personal life, emotions, memories and thoughts while exploring cultural heritage sites as places of the past. We argue that such connections can lead to people gaining deeper insights into the historical context of the site in relation to their own lives, and in doing so making the experience of exploring the historical site a memorable one. Our approach, evocative computing, is intended to provide opportunities to support the creation of associations that can leave a lingering impression on an individual.

### 3 The Setting

The setting for our main study was an old Victorian cemetery – a cultural heritage site with a rich social history [11, 13]. When walking through the cemetery we may read the inscriptions on the headstones, wondering who the person was, how old were they when they died, what they died from, what kind of life they lived and who they were related to. When we come across a headstone that shows that someone died young, it can stop us in our tracks as we try to imagine what was the cause. To expand upon our notion of evocative computing, we ask: How can we move beyond the inscriptions to allow visitors to delve deeper [8, 19], not only to make connections about the lives of the people buried there but also to what is present around them and to their own personal lives?

The cemetery (see Figure 1) is situated in a small city in the UK. There are around 20,000 burials in the cemetery, most in unmarked graves, with around 3,500 marked by headstones. Some of the headstones are very old, overgrown, and covered in lichen. The people buried there were from a variety of backgrounds and part of the pleasure of visiting the cemetery is to imagine and discover more about them.



**Fig. 1. Headstones in the cemetery**

### **3.1 The Evocative Technology Set-up**

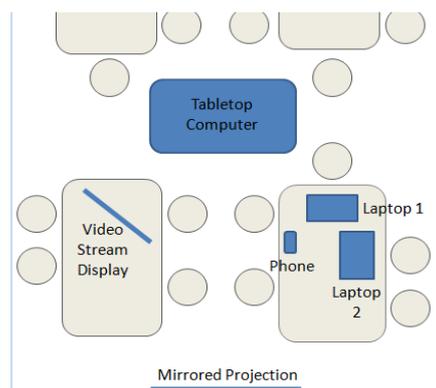
We assembled a number of interactive displays and mobile devices that were distributed indoors and outdoors for people to look at and interact with when in different locations. The technology was adapted from a previous project [10] for the specific context and challenges of the cemetery. The idea was to provide multiple perspectives when either in the cemetery or an adjoining building, in order to encourage diving in and stepping out [1], and in so doing, enabling serendipitous associations. The set-up comprised smartphones, iPads, video links and a shared multi-touch surface. Inter-linked software apps and access to digital databases were developed to run across them. A variety of lightweight interactions were made possible that only required minimal learning. A photograph could be taken, then annotated with some text, and linked with a grave on a digital map. It was considered important that interactions required minimal learning, to enable the participants to feel comfortable using them, with only a quick introduction. The iPads and smartphones were intended to be used outside – to take photos of headstones and other things of interest (see Figure 2).

A room in an adjacent building to the cemetery was also set up as an indoor space for stepping back and reflecting on what had been seen in the cemetery. The technology comprised a Surface Tabletop computer mirrored onto the wall, laptops and a screen displaying a live stream from the site. A phone was provided for discussions with those outside (see Figure 3).

The photos that were taken by people outside could be uploaded in real time to appear on an interactive bird's eye view map of the cemetery displayed on the tabletop (see Figure 4). When indoors, participants were able to see photos being added onto the tabletop view of the graves – initially appearing in the form of coloured dots. Touching a dot resulted in bringing up the image taken there, and any information connected by the participants. The smartphones also allowed for texting and phone calls to be made between those inside and those outside in order to exchange information and generally plan the activity between group members. Live video images from a camera outside were shown on a wall display indoors, providing those indoors with a live roaming feed for allowing them to see what those outdoors were doing.

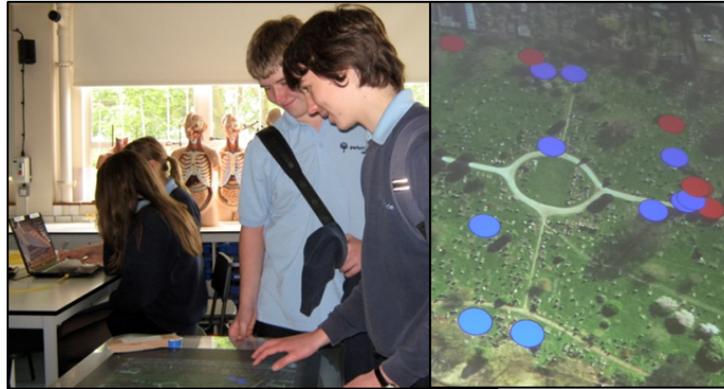


**Fig. 2.** Using mobile devices to look up database records and to photograph the graves



**Fig. 3.** Schematic diagram of indoor technology set-up

A shared content management system was created, based on the Drupal platform [14], which could be accessed from a wide range of devices to allow data to be up loaded and referred to from multiple locations. Accounts of the grave inscriptions and other parish records or copies of old newspaper clippings could be accessed. Other publicly available sources of information online, for example the digital records from the Commonwealth War Graves Commission, could also be accessed. The photos taken outdoors and the digital records were geo-referenced and mapped within the visualizations for the different devices. The GPS locations of the groups outdoors were automatically sent to a web server once every minute by the mobile phones. This location data was then displayed on the tabletop as part of the visualization. This enabled those indoors to see where the groups were outside as they moved around the cemetery. They could also see each photo they had collected, where they had collected it and any information each team had attached to that geo-referenced image.



**Fig. 4.** Two pairs of students collaborating around the tabletop and laptops (left) and bird's eye view of the cemetery on the tabletop with dots representing the graves (right)

### 3.2 The Design Process

Several visits to the cemetery were made with numerous meetings held with representatives from groups who are interested in and/or use the cemetery. One group of local volunteers was the Friends of the Cemetery who work together with the Parochial Burial Grounds Management Committee and the City's Council to protect and enhance the cemetery for the public benefit. They view the cemetery as a special type of green space – a place of remembrance, spirituality, history and wildlife.

An initial prototype was trialled in a smaller graveyard to see how easy it was to use and switch between the various tools and displays. We invited the Friends of the Cemetery to trial the prototype set-up. Small groups of 2-3 participants went outside, took photos of interesting sightings and added notes. Each group then came inside and were shown the data they had collected, overlaid on the bird's eye view of the graveyard. A strong 'wow' reaction was observed; as groups experienced, for the first time, the transition from taking photos outside to seeing them linked with where they had

taken them on a large-scale map. They were very moved by seeing their personal photos now as digital dots of where they had been (Figure 4). Clicking on them elicited spontaneous conversations about what they had seen, imagined and done there.

#### 4 User Study

The user study was run in two parts. The first part took place over a period of 4 weeks during which four sessions were held, each with 12 to 22 participants visiting the cemetery. The second part took place a year later, when we revisited participants and interviewed them about their experiences and memories. Leaving aside the group who focused on wild-life, we report here on how two groups that already made visits to the cemetery for different reasons, had their visits enhanced through the technology:

**(i) School children** A group of 22 children, aged 14 to 15, who were studying drama, took part. Their drama teacher had used the cemetery before in her courses as a source of inspiration for writing and performing plays about people, although not yet with this particular group of children.

**(ii) Local volunteers** A group of 20 adults, who had a strong interest in local history, and, in particular, how stories involving the people who are buried in the cemetery inform us of the past took part. They had been working for some time on ways to digitally map the graves and on collecting materials.

**Activity design** We considered it important to let the teacher and the person running the local volunteer group decide on the focus of their explorations, in order to give them autonomy over what they wanted to engage with in the setting so as to fit in with their own interests and activities [15]. Our role was to provide technology to evoke and connect with personal experiences and help people explore and discover for themselves. The teacher chose to develop her class around the cemetery where the pupils had to create a play about the experience of soldiers in WWI and to contrast this with more recent wars, such as the Gulf War. The cemetery has a number of WWI graves of soldiers who died serving during this war, which are located throughout the cemetery.

The local volunteers wanted to identify graves in a particular part of the cemetery. Some twenty years earlier another history group had compiled lists with details of the inscriptions on each grave. This information had been transformed into database records, but no photographs were included nor was it clear where precisely each grave was located. They wanted now to determine the location of each grave and mark them on a large aerial photograph of the cemetery as part of their local history project.

**The sessions** At the beginning of each session an initial demonstration of the devices was given. The large groups were then broken up into smaller groups of 3-4 and left to work under the guidance of their leader/teacher. Participants were encouraged to make use of both the indoor room and the cemetery, which were only a few minutes walk from each other, enabling the smaller groups to visit both in a staggered way. Each session lasted between 1.5 to two hours.

The children began by looking at the headstones to see who might have died during WWI, and photographing them. One group remained indoors, researching background

information on families, regiments and war locations. Throughout the afternoon groups around to enable all to switch between being indoors and outdoors. The volunteers in the cemetery started by photographing graves and then used the iPads to look up records in an attempt to link them together. They also interacted with the map on the tabletop indoors and guided the others outdoors on missing information.



**Fig. 5.** School children showing their photos and describing their discoveries to a researcher in the cemetery

## 5 Methodology

We used a mix of methods in order to study how the participants made use of the devices, how they approached their activities and what it was they talked about to each other. All the interactions with the technology were recorded using still photographs, video and notes. A team of researchers roamed around the cemetery observing the groups, and chatting to them informally (see Figure 5). Whenever groups moved from the outdoor to the indoor area, or vice versa, they were accompanied by one of the researchers, during which they would talk informally about what they had been doing and found. At the end of each session participants were asked to share their thoughts and impressions through a feedback form. We also held a group discussion with the teacher and children to talk about their findings and experiences.

A year later we went back to talk to the children, the teacher and the volunteers who were available. We asked them about their experiences of walking around the cemetery, using the technologies, conversations they had and whether anything had followed on from it. We spent a day at the school where the school children had now completed their drama coursework. We read the monologues they had written and also met with the next cohort of children who were just starting out on their drama course and listened to how they approached the task.

The data collected was analyzed thematically. These were refined and verified by a comparison of themes produced across the research team. The focus of our analysis was on how the participants made discoveries, *in situ*, in particular, how they used the devices and displays to make connections between their own lives and the histories of the lives they were discovering.

## 6 Findings

Our analysis revealed observable moments where participants discussed their ‘personal evocative memories’ with each other. We also observed ‘digital situated awareness’ of where they were and what they had just done. Below we present our findings in terms of a set of themes related to evocation and memory: (i) digital delight of being there, (ii) revealing more, (iii) serendipitous discovery, (iv) triggering and extending the personal, (v) personal memories and making connections, and (vi) seeing things differently.

**Digital delight of being there** Similar to the finding of the pilot study discussed earlier, key moments that occurred within both the school children’s and the volunteers’ sessions were, when after being outside taking photos, they came inside and were struck by seeing a representation of their own collected data on the big display on the wall or the tabletop. Many experienced a sense of delight on seeing the ‘dots grow’; representing their photographs and where they were positioned on the map of the cemetery in real time at the place they had taken them.

This indoor-outdoor set-up provided them with a new way of seeing their photos transformed into a collection of shared representations on a map, showing their discoveries. They looked at the map as more dots appeared, seeing what photos the others outside were adding. In doing so, they vicariously understood the process of being out there taking a photo while seeing it become a collective data point. This shared awareness gave them a powerful sense of connection - being present and stepping back, enabling them both to remember the details surrounding taking the photo and to reflect upon the bigger picture. Evidence of their joy and wonderment at this was made through their comments to each other and the researchers standing by. For example,

*‘Hey look at that! That’s the one we took, remember? When we were near that bench. ...’*

and from the organizer of the volunteers:

*‘this is amazing ... there’s been so much activity this afternoon, we’ve made so much progress, so many photos taken, and you can see all the activity on the map.....’*

The groups were also able to see at a glance how many photos they had taken relative to the other groups – which was particularly fascinating to the school children as they were seen discussing this with their teacher. It also led them to get in touch with the other groups outside, texting them to say how well each group was doing and what photos they were taking.

**Revealing more** One of the volunteer groups tried to fathom out which inscription entry in the database matched with which grave, and where each grave was located. Another group was seen spending a lot of time around a particular grave trying to decipher its inscriptions. The stones were covered with a layer of lichen, a soft mossy type of fungus, making it particularly difficult to discern the writing. They were seen feeling the stone, with their fingers, to make sense of the engravings. Later on, the

same group was seen using the tabletop indoors. They were looking at the photograph they had taken of the gravestone that was so difficult to decipher. By zooming in on the photograph, and enlarging it, they noticed that it was easier to decipher some of the lettering, exclaiming how the zooming action on the tabletop enabled ‘magnification of the picture’ that resulted in further conversations about the person buried there. This was a very pleasing moment for the group as the tabletop was able to support them in an activity that was causing them difficulty outdoors and showed a use of the tabletop that they had not anticipated. The moment was powerful, particularly since they had only just come from outside, having spent considerable amount of time around the gravestone. While outside, they had used both the iPad and the smartphone to try and identify the gravestone, but it wasn’t until they were inside, that they managed to successfully do so.

**Serendipitous discovery** Whilst looking at the map of the cemetery, one of the participants accidentally pressed a dot on the map, which was associated with a different grave, near to the one they had just identified. This brought up the associated description of a famous local historian, John Seeley, who was buried there. Another volunteer (who was also a historian by profession) glanced at the description, read it and jumped up in amazement:

*‘Seeley... Is that really him??’*

*‘Seeley ... he’s a really really great man! Professor John Seeley ... he’s the big researcher into the British Empire.’*

He continued to explain how university buildings in the locality are named after him and regaled stories of Seeley’s infamous dinner parties and what happened at them. He then looked at the tabletop to find out exactly where this grave was in relation to the others on the map. All of the group were drawn in by his anecdotes and stood around the tabletop discussing where the grave might be through studying the pattern of dots. It transpired that the grave was right next to where he had been exploring all day but hadn’t noticed the gravestone until this moment:

*‘I’ll have to go back and find him now. Well that’s amazing – not quite like finding Shakespeare but... yes, it’s on the same scale. Heavens, as it happens, I’m actually teaching about him right now.’*

He then left the room to go back to the cemetery and found the grave. His excitement at finding it was palpable and after spending 20 minutes out there returned to tell everyone about his discovery.

**Triggering and extending the personal** A year later, we met up with him and asked if he had looked back on that afternoon’s discovery. He replied emphatically that finding that grave had been a special moment for him. He had referred to it on several occasions during his lectures and at international conferences. He also reflected more widely on the value of local buildings and graveyards and their potential for teaching history to students through situated discovery:

*'For many years I have had something brewing at the back of my mind, about trying to do something like this in teaching. Taking students out to places, local building, and letting them do research about people that lived and worked in the area. For me these ideas sit at the back of my mind for a while. I get an idea and it all gets put into a store, perhaps for many years, slowly taking shape. And then something like this happens ...'*

Hence, finding the particular grave had triggered something greater in him, as he was now actively reorganizing his teaching schedule so that his students would have more opportunities to go out to visit the local cemetery. His new approach to teaching had been evoked through the powerful moment in the cemetery.

The dots in the visualization appeared to have had a strong impact in this experience. It was he who brought up the role of the digital map application and it was clear that he could still imagine the visualization in front of him. He mentioned how he had expected the dots on the map to present an anonymous image of the cemetery: expecting each dot to represent some facts about an unknown, local, rather insignificant person. However, to his surprise, one of the dots sprung up the details of a person who was, and still is, of great importance to him personally, someone who had been tremendously influential to him throughout his whole working life. Despite all he already knew about the person, the technology had supported a new, evocative experience and with lasting effects.

**Personal memories and making connections** As anticipated, the school children, when wandering around a part of the cemetery used the iPads to help them find out more about the war graves. Sometimes this led them to think back on their own family histories. For example, one group found two graves that matched with names on a list, photographed them and then uploaded them to the system. Another group indoors confirmed that they were on the right track. They then stumbled across a big family grave, with a long list of names and dates, including one for 1917. This grave was made of crumbly stone and the inscription revealed that the soldier died abroad in 1917. While photographing this grave, one boy began to talk of his grandfather and that he had served in the Balkans during WW2. This sharing of a personal memory triggered a further discussion of war amongst the group, and in particular the different countries that were involved in the two wars.

Throughout the day, there were several accounts of where the school children switched between everyday moments, personal memories and their drama project research. In addition, their experiences were embedded in the goings on around them (e.g., stroking a dog, chatting with homeless people sitting on a bench). The combination of these with their discoveries when switching between the cemetery and the set-up indoors made a big impression, creating an overall engaging and memorable 'time'. The situated experiences, arguably, increased the intensity and recollection of them as subsequent personal memories. Such memories were often emotive, heightened by the context of death and according to the teacher, a few weeks after the event, the visit to the cemetery was still being talked about frequently amongst the school children in the classroom, in the corridors and even at home.

When we met the children a year later, they were eager to tell us about the monologues they had written and about the characters they had chosen as a result of the visit to the cemetery. They were also reflective and mentioned how they had made connections between the war, the visit to the cemetery and their own families:

*“I talked to members of my family about the people - about their experience of knowing and losing - a person in the war.”*

*“In the summer, when I was in Germany, I spent more time in a graveyard there. In the village graveyard, where both my grandparents and my great-grandparents are buried. I visited graves and looked at them. In Germany, because of the way they do graves, like, they have different rules. There wasn't any war people buried there. But that's to do with their traditions. But it was just, I know, it was just different.”*

Exploring a cemetery during the vacation was not a regularly occurring activity for him – in fact he had never looked at these family graves before. Clearly it linked to the earlier experience of walking around the cemetery with his school friends the previous year. The personal memories of his grandfather *then* had helped him make connections between himself in the graveyard, with his friends, and the war and the countries that were involved in the war – but he was now extending this experience, by following it up with explorations of his own family.

**Seeing things differently** Several times, throughout their explorations of the cemetery, the school children reflected upon what they noticed and looked up using the iPads and tabletop apps. For example, one group when switching indoors after exploring outdoors looked up background information of the regiments. During the group discussion one boy remarked:

*“It is odd - that when you are in the cemetery, you only think of the person's death - where they died, when and how they died - and yet, when you are here (inside) and look into it more, you think of their life”.*

Having the same information – a soldier's name – can be used through multiple representations: inscribed on a gravestone, listed as a digital record, or as part of a description of a regiment and its action during war. These multiple representations allowed participants to look through different lenses at the same person, often having a powerful evocative effect.

During our discussion with the school children a year later it was noticeable that they did not specifically refer back to the technology they had used (phones, iPads and interactive tabletop), suggesting it was largely transparent to their ongoing activities. The exception, however, was the dots visualization on the tabletop, which continued to stand out:

*“What was so startling was that you go out to find out about a world event – a world war – which is a large international event, where countries are fighting.*

*War is about big numbers, about stats. (...) - when you're in the cemetery you see the graves – well, you saw the dots on the map – you see the scale of it. It's a big scale."*

The teacher remembered how the activity greatly impacted on her drama course: *"These were remarkably reflective pieces that this group wrote. They were very thoughtful. They really went into the characters and I am really pleased with what they produced."* For her, like the historian who had changed his approach to teaching, the experience had led her to reflect on her teaching: *"It is also exactly how I think they should research (site specific), hands on, out there learning"* and *"Whereas before, I would have encouraged pupils to make lots of notes when visiting places, to help them start preparing for their narratives – I now tell them to bring their phones to school, so that they can make photos of the things that strike them as special or unusual, in order to be able to remember where they were."*

When meeting again with some of the local volunteers, they talked purposefully about their experiences of locating and identifying the graves in the cemetery. Underlying their concerns about data collecting and how to store data, there was a sense that the sessions in the cemetery had helped cement friendships across the group – they looked back on the sessions with great fondness, recalling moments, and people and who had said what when.

## 7 Discussion and Conclusion

Our study has shown how an assortment of technology can be designed and used in a historical setting by groups of visitors to discover much more about the lives and social history of people buried in a cemetery that they were able to relate to their own personal histories. Moreover, the experiences were found to be long lasting; through using the devices and displays distributed indoors and outdoors, the participants made a variety of connections between their own lives and the lives of the people they were exploring that one year later, they were still talking about.

Our research raises the question of how do memories created through the evocative computing approach differ from those arising from just visiting a cemetery or other place of interest/historical site, without the range of technologies we assembled, and perhaps only having a mobile phone to hand. Clearly, it is possible to connect personal memories with the surroundings of an ongoing activity unaided by technology and to take pictures that can be looked at later. What role did the technology play in making the experiences so engaging and memorable? Below, we discuss possible ways our evocative computing approach enriched the user experience.

**(i) Multiple and memorable representations** A technology that played a central role in the linking of discoveries and personal experiences was the tabletop visualization, where the dots appeared in real-time representing pictures taken and information recorded. The participants were able to see the dots as something other than places on a map where photos were taken; more akin to a synecdoche between their discoveries,

activities and memories: when, where and what the photos they had taken meant to them. The dots were the most remembered part of the technology set-up when talking about the experience a year later. They acted like a memory cue, similar to Mancini et al's [18] idea of a memory phrase, which enables people to go back to the memory of particular events and retrieve salient and emotive aspects of their experience in detail. Whereas Mancini et al deliberately asked people to make up a memory phrase in their study, asking people to remember what they were doing at various times of the day for a project on mobile privacy, the 'line of dots' emerged serendipitously for our participants. For example, for one boy, the dots led him to marvel that worldwide events were happening on his doorstep: "you think of WW2 and you know it's big stats, but then it is happening in my locality, that struck me – it's here". For a volunteer, it was the epiphany of the unexpected: he had expected the dots to represent local people, with local issues and local stories – and instead discovered that the grave of a revered historian was on his doorstep.

**(ii) Intertwining place, information and narrative** The findings from our study show how the volunteers began to understand how the role of technology is not just about placing documents and photos in databases and archives, but that it can also support their physical interactions with aspects of the cemetery, and each other.

**(iii) Connecting personally meaningful, local and global** Research in HCI on memories and cultural heritage, historical events and places has tended to be separate. The connections between these are rarely made, and often local places, close by and with the potential to be exceptionally evocative, are ignored thus giving little importance to people's autonomous engagement with cultural heritage in the context of their own lives and the specific settings of where they live [15]. Here, we demonstrated how strong links can be seen between them. For example, the school children realized how the cemetery could trigger personal memories that made war history more meaningful and closer to home.

Our findings suggest, more generally, that the evocative computing approach can lead to meaningful and lasting experiences. It provides a way of thinking about how to enable visits to digital heritage sites, such as castles or ruins, to be enhanced not just during them, but also to create long lasting memories in a person's life. Specifically, by having multiple connected technologies at hand, different entry points for serendipitous experiences are made possible. The kinds of 'wow' moments we recounted may not always arise – but that is the essence of designing for serendipity. You cannot design directly for but you can provide opportunities. As our study revealed, participants readily switched between these entry points, uncovering information as and when they wanted – thus revealing the hidden which they could make into new persistent connections. Evocative computing works as an approach to support open-ended and user-created trajectories across space and time – that is different from trajectories or tasks designed and orchestrated by others (e.g. teachers, curators, designers).

In sum, the technology can act as a kind of glue enabling people to make connections between different aspects of their experiences later on. This suggests that when designing user experiences we should consider a range of temporal aspects, not just the immediate experiences of using technologies but also what the long lasting impact

will be of interacting with them. Hence, an evocative computing approach should consider providing conditions rather than pre-defining expected outcomes. Finally, technology has often been designed to enhance specific experiences taking place at specific moments. Often the joy, wonderment and pleasure of an event are assumed to occur if people simply interact with an experience. However, our research has shown the value of enriching a personal and emotive moment through technology that then makes this a lasting, meaningful experience.

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