meSch – Material Encounters with Digital Cultural Heritage

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Abstract. The meSch project, Material Encounters with Digital Cultural Heritage, has the goal of designing, developing and deploying tools for the creation of tangible interactives that will connect the physical experience of heritage with relevant digital cross-media information in novel ways. A wealth of digital cultural heritage content is available in on-line repositories and archives, but is used in a limited way and through rather static modes of delivery. meSch enables heritage professionals to create physical artifacts enriched by digital content without the need for specialised technical knowledge. The approach adopted is grounded on principles of co-design, the broad participation of designers, developers and stakeholders into the process, and on a Do-It-Yourself philosophy to making and experimentation. The ambition of the project is to enable the creation of an open community of cultural heritage institutions driving and sharing a new generation of physical/digital museum interactives.

Keywords: tangible interaction, smart exhibits, co-design, reuse of digital resources, museums, museum visit, Cultural Heritage.

1 Introduction

The current developments in cultural heritage on the web, show that heritage institutions achieve digital engagement with visitors by social media presence, crowdsourcing

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projects and publishing on mobile media, including tablet computing and BYOD (bring your own device) [6]. There is an overall sense that GLAMs (Galleries, Libraries, Archives and Museums) have mastered the demands of the digital age as much online digital resources are available, whether it is in large repositories like Europeana, on institutions' own websites or in the cloud as (linked) open data. The adoption of digital media is, however, uneven: while some are still making effort to digitize their collections, others are exploring what to do with the wealth of digital heritage. How to improve the use of existing resources and make the digital heritage really meaningful for users, especially now, on the verge of the post-digital[1] age, is the new frontier for research in cultural heritage. The first step forward is the electronic publishing of digital content to take advantage of the spreading of tablets and reading devices [6] and the adoption of natural user interfaces, particularly gesture and haptic devices [6].

The adoption of new advanced digital interactive technologies, however, does not tackle some of the drawbacks that have been identified such as failing to achieve simultaneously a "hands-on" and a "minds-on" experience [2]; disrupting the sensitive museum ecology by driving the attention of the visitors away from the objects on display [11, 12] to the museum interactive or device instead; isolating visitors from their group and thus diminishing the pleasure of a social experience [7]. We see this as a call for integrating the material and the digital collections into a seamless integrated experience for visitors. The current availability of sensors, very small computational devices and their wireless networking, have brought about the concept of Internet of Things where physical objects are uniquely identifiable and have virtual representations in an Internet-like structure. Most objects in a museum collection already have corresponding digital information, what is missing is the connection of the real object with its digital shadow in a non-intrusive way, that has the potential to open new ways to create personalized, tailored and tangible visitor experiences – beyond the mobile screen. This is one of the three goals of the meSch project: the seamless integration of the physical experience of heritage and the wealth of digital media and information available about it, by applying in an innovative way principles of tangible, embodied and embedded interaction to experiment a digital enhancement of the objects and/or the space surrounding them that keeps the heritage at the centre of the visitor's attention and invites social dynamics.

As visitors have different motivations [5], there is the need to support heritage professionals in designing experiences that are specific for those different goals. In meSch we make use of personalization techniques to adapt the narratives prepared by the heritage professionals to the specific context of the individual visit. We also use techniques typical of recommender systems and contextual search to support heritage professionals in finding content and composing narratives for different visitors' categories. Personalisation for both visitors and professionals represent the second major aim of meSch. An advancement of the state-of-the-art of personalization technology is sought to guarantee the effective adaptivity of both the content and the interaction, with sustainability as one of the major requirements: narratives and interactions

[1] In a "post-digital" era the presence of digital information is not questioned anymore, but given for granted, while the awareness of its limitations and drawbacks increases.

created by heritage professionals must be reusable for different exhibitions and be easily portable to new domains.

A further challenge constantly faced by heritage institutions when adopting sophisticated technology is the cost of making and its management: the higher the complexity, the higher the cost and the dependence on external companies for the development, set-up, installation and maintenance of their interactive interpretation media or exhibits [13]. There is currently a flourishing of interest around digital fabrication and do-it-yourself practices, both within the digital technology community (e.g. Maker Culture and the Maker Fair) as well as within more traditional crafting settings (e.g. Etsy). The third goal of innovation of the meSch project is to provide technology that can be handled by heritage professionals and that allows them to create interactive exhibits within a limited budget and with limited technical expertise thus encouraging the development of a maker culture within the heritage community.

Before discussing the vision and the current development of the project, it is important to briefly describe the approach adopted, that of co-design, as it is steering the project towards solutions that are more likely to be useful, usable and ultimately adopted by the cultural heritage community. In co-design practice all stakeholders collaborate and share responsibilities and decisions at every stage of the process. Cultural heritage professionals, designers, computer scientists and engineers have been working together in co-design workshops to imagine, design and shape the meSch project. Among the twelve partners from six European countries three are prominent international museums: the Museo Storico Italiano della Guerra, Italy (national historical museum of war), the Allard Pierson Museum, The Netherlands (an archaeological museum), and MUSEON, The Netherlands (an educational museum with an eclectic collection). Directors, curators and educators from these museums have been involved in a number of creative activities, from scenarios exploration and bodystorming, to sketching in hardware with ubiquitous computing technology, all aiming at teasing out their knowledge and making them aware of the technical possibilities offered by ubiquitous computing (Fig. 1). The opinion of the three cultural heritage partners has been integrated with views from the broader community through a set of interviews and workshops; the result of this broader consultation with the community has been fed into the meSch project co-design activities [8].

Fig. 1. Different activities carried out in co-design workshops

2 An Integrated Approach to Technology for Cultural Heritage

meSch integrates technology into the visitors' physical experience with cultural heritage instead of creating a parallel and detached digital experience [10]. The vision is of

a cultural space with smart objects, each with their own digital content embedded therein, which will be revealed if and when conditions are right, e.g. visitors have reached the right time in the storyline, or a group of them is acting in a certain way, or another smart object is close by. Whilst technically this has been possible to a certain extent for some time, to fully achieve this goal and make smart tangible objects sustainable for heritage institutions, curators and exhibition designers have to be provided with a simple hardware and software platform that supports them to conceive, design and make, as well as maintain, interactive artefacts. Thus, as a major contribution towards filling this technology gap, meSch designs and develops a hardware and software platform that enables cultural heritage professionals to create tangible and physical experiences that best convey the value of their institutions to their visitors.

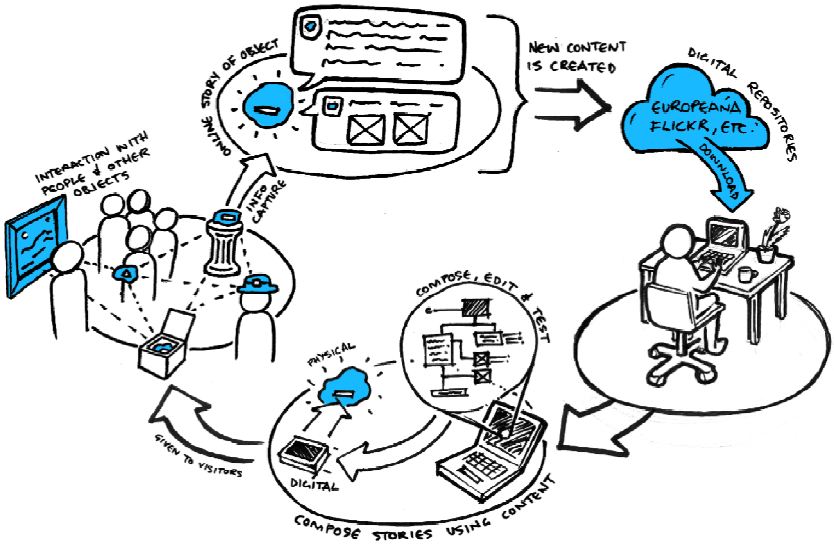

Fig. 2. The meSch lifecycle shows how digital and material collections are integrated making a full cycle from the digital to the physical and back to the digital

Figure 2 illustrates the stages envisaged in meSch (clockwise from right):

1. the author (a cultural heritage professional) retrieves digital content from integrated multimedia digital repositories that may be local to the heritage institution or public online resources such as Europeana; this activity of relevant content searching is facilitated by a recommender system: by monitoring the activities of the author meSch is able to suggest content that is not currently in focus but that can be relevant for the task in hand;
2. snippets of multimedia content selected in the previous step are organized in a network of multiple parallel narratives, each node controlled by a context-of-use condition; the conditions implement the context-sensitive aspect of meSch and can refer to the visitors (e.g. different motivations); the environment (e.g. where the visitor currently is); or the interaction (e.g. places already visited or stories already heard); this phase is an iterative cycle of composing and testing

(in simulation); when the author is satisfied, the executable is downloaded to a smart interactive device that is encased within different skins or used to compose reactive spaces;
3. the devices created in phase 2 are part of an ecology of smart objects that interact with each other, the visitors, and the space and provide personalized content in context; every aspect of the interaction is recorded in logs of activities that allow to further refine the personalisation of the visiting experience (e.g. by creating souvenirs based on the individual visiting log collected) and feed the online interaction described next;
4. the smart objects have an online shadow that logs the visit for further use such as connecting with online heritage repositories or simply to social media; the logs collected during the visit are used to personalise the online experience, such as propose a new visit (onsite or online) on the basis of past ones; the curator can use the log to monitor how the exhibition is going, analyse the visiting patterns and improve it.

By shifting the focus of research from the audience to the curators, meSch aims at fostering a more creative use of technology, facilitating the creation of novel ways of using and communicating heritage. To create an engaging experience, the curator or exhibition designer must have the ability to design interactions that span multiple smart objects in the exhibition and allow their interlinking in meaningful ways. During the visit, elements in the track created by the cultural heritage professional will be progressively experienced by the visitors, each in their own way, creating a unique and personal visit.

3 Combining Digital and Material: Examples from meSch

In this section three examples of novel types of visiting experiences developed in meSch in the first phase of the project are used to illustrate the idea of fusing the digital and the physical. We hope that this gives an idea of the variety of the radically different experiences the meSch platform will enable heritage professionals to create.

3.1 The Loupe to Explore

The Loupe is a magnifying glass that reveals different layers of digital content when pointed over specific objects that have been augmented (Fig. 3). The technology used is Augmented Reality (AR), by means of a smart phone embedded within a wooden case, but the experience of using it is very different from holding a tablet. The visitor engages in an exploration to first find and detect the object profiled on the Loupe screen in order to reveal multiple "hidden" AR layers of content before moving to the next object on the trail. The Loupe makes also use of the optical zoom feature of the smart phone to display details that are not visible to the naked eye. Although the technology used is not particularly advanced or new, the encasing within a physical form that the visitor easily recognises changes the experience of triggering AR. Indeed the current version that displays the profile of the object to find at different stages of the

trail emerged after a number of trial tests that showed how pointing a device to an object for triggering Augmented Reality can be very difficult and frustrating for users[2]. This solution facilitates the task and at the same time introduces a game-like dimension in the experience that now resembles a quest. The trail and the content were created by the staff at the Allard Pierson Museum.

Fig. 3. The Loupe in use at the Allard Pierson Museum

3.2 The Interactive Cases to Talk to Objects

The Interactive Cases have been bespoke designed and built to instigate curiosity via a Twitter conversation with the object and other visitors. The set of four cases was co-designed with and installed in MUSEON (Fig. 4); the installation proposes a "competition" among 20 objects (generally stored in the deposit) to be displayed in just 4 cases; the purpose is for MUSEON to gain a sense of what types of objects, within their vast collection, generate more interest among the visitors (possibly to inform future exhibitions). Each case displays a museum label, stories from the exhibit (told in the first person) and the flow of twitter messages received and/or generated by the object in the case. The dynamic display allows to project content in many languages, in this example English and Dutch. The installation "measures" the interest of visitors by measuring and analyzing the number of visitors that stop in front of each case and the number of twitter messages received by each exhibit: this information is used by the curators to decide which object is the least popular to be swapped for a new one among the 20 selected. The idea of a competition was inspired by a recent catalogue published by MUSEON of a large set of exhibits, including objects that are found in the deposits but deserve to be seen. Part of the content comes from this catalogue integrated with ad-hoc information and tweets.

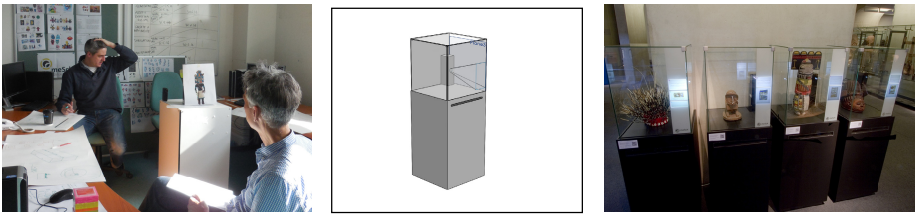

Fig. 4. The conception and co-design and the interactive cases as installed at MUSEON

[2] The option of placing markers close or on the object was never considered as it would affect too much the display of the exhibits. Markers placed on of the floor were not very effective.

3.3 The Interactive Belt to Personalise a Soundscape

An outdoor heritage may pose some striking challenges, e.g. no power supply or mobile phone network, but offers the opportunity to experiment with media that may not be easy to use in indoor museums as it is the case with spatial audio. To support the visit of the architectural remains of the trenches of WWI located on the Alps in the north of Italy, we designed a belt that allows visitors to select the type of story they want to listen to, by placing an illustrated card into a slit in one of the pockets hanging from the belt. Their presence in specific points of interest triggers evocative stories from the war, such as diaries, poems, military orders and tales from the life of the women left behind. Which sound is played depends on the story selected by the visitor via the card, their current location and the interaction/visit so far. The sound is played by loudspeakers hidden in bespoke lanterns that conceal the electronics but fit the natural environment. The content comes from the archives of the Museo Storico Italiano della Guerra and was elaborated and prepared as oral narratives and evocative sounds.

Fig. 5. The interactive belt in use on the trenches of WWI (Museo Storico Italiano della Guerra); the hanging lantern contains the Bluetooth receiver and the loudspeaker

4 Shaping Personalisation around Cultural Heritage Needs

Core to meSch is the implementation of personalisation mechanisms that accommodate different visitors and satisfy the need of cultural heritage professionals. Personalisation delivered in cultural heritage scenarios has been a topic of research for more than two decades [1] and a number of different personalisation features have been proposed and tested [9]. Implemented systems usually concentrate on a single specific complex feature (e.g., visiting style) or on a subset of easy to model features (e.g., visitors' age, stereotypes, location), leaving out other personalisation dimensions highly valued by cultural heritage professionals (e.g., motivation for the visit [6]) [9]. A clear understanding of which features should be prioritised among the many possible and why is still missing. Moreover the adoption by heritage institutions, requires scalability, maintenance, and portability of the system to new domains and physical settings.

A co-design workshop with heritage professionals helped us to understand their needs and shape the design of personalisation functionalities that address the actual priorities with the most sustainable implementation solutions. We asked participants from the heritage community to contribute their thoughts on what must be changed in

a visit to achieve personalization. A comparison of the results of this user-centred study against the classification derived from the literature showed that features in the literature such as 'visiting style' and 'personality' have not been mentioned at all by the curators, who considered the actual visit motivations ('fun', 'information seeking', 'just killing time',..) core to explain the type of experience the visitor would like to have today [9]. Significant is also the large number of terms generated in the user-centred study that has never been addressed before by the scientific community. 'Unexpected', 'mood', 'personal involvement' clearly indicate an interest for interactions that point toward emotion rather than information (a trend in museum studies too, e.g. [4]). In order to achieve an emotive engagement, in meSch we explore how to offer visitors different types of experiences designed to match alternative motivations for the visit and thus different emotional statuses [6].

Personalisation in meSch occurs at two levels: personalization of content, when different content is offered to different people; and personalization in context, when the decision on which snippet of content to deliver and how is made on the basis of the current situation. In meSch we are working towards a personalisation system that allows the curator-supervised creation of the experiences (both stories and interaction), leaving to the system the burden of dynamically adapting multi-narrative content to the visitors' context and history [9].

By combining aspects of curator-supervised customisation, system-controlled adaptivity and visitor-driven adaptation we expect to achieve a greater level of flexibility and portability of the meSch system, as well as a better fit around the cultural heritage perspective on personalisation.

5 Do-It-Yourself, Do-It-With-Others: The meSch Community

It is clearly not a lack of ideas that acts as a limiting factor for curators to adopt innovative technology. It is more likely the need for technical knowledge and skills paired with the high costs of interactive exhibitions. The aim for an easy to use platform is sought in meSch through a process of co-design that involves cultural heritage professionals, computer scientists, and interaction designers. By easing the creation of software and hardware prototypes, we expect to enable a paradigm change: from interactives created for museums to interactives created by museums. As illustrated in Fig. 1, meSch aims at an easy to use hardware and software platform that allows non-technical cultural heritage professionals to choose among a range of possible tangible interactives for their visitors, compose their content into interactive narratives for a given visitors' experience, create the physical devices, install them in their cultural heritage sites, monitor their use and manage the overall process.

To enable non-technical users to create such complex interactions a set of different templates, each specific for a certain visitor experience, will be made available to heritage professionals to populate with content and create interactive exhibits. We envisage many templates for many different experiences that can be re-used and modified for different exhibitions, starting with the prototypes developed in meSch, e.g. those described in Section 3, that will be made available to encourage the growth of a

community of interest around this novel technology and foster experimentation within heritage institutions.

The meSch vision -whereby authors will be creating their own exhibition out of existing digital content, sharing their tools and experience with others in online communities- fits with a growing movement of Do-It-Yourself that is spreading from home crafts to open design for making-your-own-products in dedicated public facilities, i.e. fully equipped workshops such as FabLabs. Two examples of this kind of communities exist in the cultural domain, Open Exhibit and Pachyderm both based in the USA; they foster the autonomy of cultural institutions by providing tools that can be used with no or very limited assistance from a third technical party. These early examples suggest alternative ways other than the standard commercialization of museum applications: new models that "foster an economic and social climate which supports [individual and collective] participation in cultural heritage activities" (Council of Europe – the Value of Cultural Heritage for Society 2005). The technology developed within meSch offers to cultural heritage professionals new possibilities and hands-on tools to independently and relatively affordably create experiences that cannot be replicated in any other form, and to provide their audience with an innovative and significant cultural experience. One can imagine consortia of small/medium museums across Europe sharing the cost of making adaptive smart objects and customizing the content for their audience by changing the language when it is their turn to host it; or national museums renting their last installation to provincial ones reaching out to an audience that would not travel far, e.g. the elderly or schools.

During the whole life of the project, we will put effort in creating awareness and interest in the cultural heritage sector to kick-start a meSch community that could try some of our prototypes as beta-testers and contribute ideas and examples. This will include social media as well as events targeted to heritage and museums.

6 Conclusions

meSch is a 4-years EU funded project (2013-2017) aiming at developing technology for the heritage professionals to create interactives that integrate digital content into material objects or physical experiences for the different kinds of consumers of heritage today. Now concluding its first phase, meSch has so far explored the potential of the most recent technology for pervasive and embedded computing and what that holds for the future of cultural heritage. This exploration, although led by the technical partners, has been inspired by a set of co-design workshops inclusive of all expertise and background held to brainstorm on scenarios of use, for both visitors and heritage professionals. Workshops, exploratory labs and prototypes allowed the multidisciplinary team to share experiences and create a common understanding on what needs to be done. This was instrumental to lay a solid foundation for the following phase when the meSch platform is fully designed and implemented. Currently the integration of some digital resources into a single access point is being carried with the aim of achieving a first preliminary prototype at the end of the second year. This prototype will then be used to enable cultural heritage professionals to create interactive exhibitions for the general public that will be substantial case studies for both

assessing the value of tangible interaction for visitors as well as the actual ease of use of the tools under development. meSch is also active in the dissemination of the ongoing work and early results on the project website http://www.mesch-project.eu

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