Co-designing a Collaborative Platform with Cultural Heritage Professionals

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ABSTRACT
The paper describes our work undertaken as part of a EU-funded collaborative project involving twelve partners from six European countries, aiming to provide a platform for the creation of tangible smart exhibits to enable heritage professionals to design and assemble physical artefacts enriched by digital content in a DIY manner. Our approach 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. Hands-on design and prototyping workshops are employed throughout the project to inform and shape development. The paper focuses on these co-design activities, wherein cultural heritage professionals (CHPs), designers and technologists work together in local and consortium-wide workshops to co-create the DIY platform. It presents the results of an investigation into the design thinking, practices, and processes of a particular set of users - cultural heritage professionals – who are involved in the design and realisation of cultural heritage exhibitions involving digital interactive technologies.

Categories and Subject Descriptors  
[Interaction design] Interaction design process and methods

General Terms  
Design, Experimentation, Human Factors

Keywords  
Co-design, cultural heritage, interactive exhibits

1. INTRODUCTION
The research project described in this paper has the goal of designing, developing and deploying tools for the creation of tangible interactive experiences that connect the physical experience of museums and exhibitions with relevant digital cross-media information in novel ways [9]. A wealth of digital cultural heritage content is currently available in on-line repositories and archives; however, this content is not widely utilized and the current delivery models are rather static. Our project proposes to bridge the gap between visitors’ cultural heritage experience on-site and on-line by providing a platform for the creation of experiential smart exhibits, that will enable heritage professionals to compose and realise physical artefacts enriched by digital content without the need for specialised technical knowledge; the platform will include an authoring environment for the composition of physical/digital narratives to be mapped to interactive artefacts, and an embedded multi-sensor digital system platform for the construction of ad-hoc physical adaptive smart objects. The ultimate goal of the project is to support the creation of an open community of cultural heritage institutions driving and sharing a new generation of physical/digital museum interactive exhibits. In order to empower cultural heritage professionals to do so, it is first of all important to investigate the potential of their role in acting as designers of such interactive installations and in taking on control of technologies that can be customised or modified to suit the needs of an institution.

In the following sections of this paper we will present a discussion of existing research related to the topic of interactive exhibition design, design processes and the design of cultural heritage toolkits. We will then report on the process of co-design and present a review of the co-design activities undertaken throughout the first year of the project, followed by an analysis of the main findings that have emerged from it. We conclude the paper with a discussion of the key challenges in designing and deploying innovative and collaborative technologies such as the DIY platform and how the design of interactive exhibitions by cultural heritage professionals could be supported. By presenting some of the lessons learnt that could be of interest to other researchers when extending design practices to include participants not accustomed to this type of creative practice, this work intends to contribute to the larger research agenda of collaboration technologies and participatory design within the HCI field.

2. BACKGROUND
2.1 HCI and Interactive Exhibits in Cultural Heritage Settings
Within the HCI community, an established body of research examines the design, development and evaluation of technology-driven interactive exhibitions in various heritage settings. The “users” of such technologies have been almost always considered to be the visitors and research tended to focus on the visitor experience of interactive artefacts in cultural heritage exhibitions and on how this experience can be supported and enhanced [13]. While visitors are the ones who ultimately interact with these artefacts in exhibitions, the role of cultural heritage professionals

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in shaping and often maintaining such installations has not been given the same attention and there has been little research on the design thinking, processes and practices embraced by these professionals who are behind the creation of interactive exhibits. Cultural heritage professionals have often taken on the role of advisors in the majority of technology design endeavours in museum contexts, while in few cases, they were actively involved in the design [4, 14, 6, 7, 10]. However, it is more commonly the case where the main responsibility for the design of such exhibits falls ultimately with others including the likes of technology experts, design consultants, media consultants and researchers.

2.2 Approaches to the Design Process

The approaches to design and the design processes applied in creating interactive museum exhibits are diverse. For example, within a user-centred design frame, end-users (i.e. visitors) and other stakeholders are studied to assemble design requirements for the interactive exhibits, and evaluation is conducted by investigating visitor interactions and by gathering data on visitor opinions and reactions to the technology [4]. However, other examples of work exist where the approach to the design process is participatory, and various stakeholders are included within the team so as to incorporate the knowledge and expertise of relevant communities into the design decisions. Participatory design methods can be used to gather design ideas for interactive exhibitions from a target visitor base. Recent work explores the involvement of children in the design of interactive exhibitions in museums [3]. There are also, albeit fewer examples of a participatory design approach to the creation of interactive exhibits that see the inclusion of CHPs within the design team, providing expert advice on content, the curatorial goals of the institution and its educational mission [13]. Designerly approaches such as reflective practice and meta-design have also been adopted by some interaction design research projects on interactive exhibitions [5].

2.3 Cultural Heritage Toolkits and Cultural Heritage Professionals as End-users of an Interactive System

As previously mentioned, the overall motivation of our research is to develop a toolkit that would allow for cultural heritage professionals (CHPs) with little technical knowledge to create interactive exhibitions merging digital content with tangible objects. A limited body of research exists on the development of cultural heritage toolkits and on CHPs as end-users of an interactive system, however, to our knowledge, there are very few examples of HCI projects that focus specifically on the design of smart exhibits. For example, toolkits have been developed for the creation of virtual interactive exhibitions, such as ARCO [12], and of screen-based exhibitions, including ‘Curator’ [11] for tabletop exhibitions; and more recently, a toolkit for the creation of tabletop-based guiding tools was built [1]. While these examples contribute to the growing interest in the theme of heritage professionals as designers of interactive exhibits, they do not offer comprehensive insights into their practice and experience of creating interactive exhibitions. To this end, we have identified a significant gap in relation to the knowledge and input of heritage professionals in the development of interactive exhibitions, and their design thinking and processes.

3. COLLABORATION AND EMPLOYING CO-DESIGN THROUGHOUT THE PROCESS

The collaborative relationships amongst the different partners as strengthened through the co-design activities is recognised as a powerful way to bridge the gaps between the different disciplines and to develop contextually appropriate solutions. The project’s co-design approach provides the opportunity for technical partners, designers and CHPs in the consortium to build a shared understanding, work together and discuss issues and opportunities in developing the authoring tool. As a multi-site, multidisciplinary project, it explores the challenge of co-designing in a very complex and distributed setting: the consortium partners come from 12 different institutions and the expertise of project members ranges from museum curators and product designers, to computer scientists, electronic engineers and social scientists. Through the practice of co-design, the collaborative work allows for a deeper understanding of CHPs’ practices, for instance, for the curators to clarify what they want to enhance in the museum and what kind of connections with digital content they envisage, the desired functionalities for the authoring tool, basic templates that could ease the start of authoring, and the design requirements for offering personalised cultural data to end-users. Importantly, the co-design activities also aim to empower CHPs, considering them as ‘co-creators’ rather than simply informants in the design process.

This co-design methodology is implemented within a learning-by-doing framework: the smart exhibit prototypes developed so far are not seen as demonstrators of achievements, but as a way to learn through the process of making. This is a well-known practice in design research that advances the project iteratively through design and evaluation phases. Iterations are functional to the project’s progress toward its final goals.

3.1 Co-design Methodology and Activities

Over the course of the first year of the project, a variety of methods have been employed by the project team to deepen our understanding of cultural heritage institutions, the practices of visitors and CHPs and the particular requirements regarding technology management and authoring. Site observations, surveys and interviews with more than 20 CHPs have been used within the project in conjunction with hands-on co-design activities to explore their experiences and strategies in designing interactive exhibitions and to inform our research. Generating design concepts and developing prototypes is a means of research within the project. Through the creation of visitor storyboards and prototypes we have been able to elicit reactions from CHPs and cultural heritage audiences and to understand the flow of the creation process that needs to be facilitated by the DIY toolkit. The prototyping activities occurred over time and the process of developing scenarios and prototypes has not been linear. Multiple ideas were generated in every co-design activity and no selection process was put in place: good concepts emerged in a natural, organic way, as similar concepts were proposed and elaborated at different points in time and in different circumstances. The different concepts that somehow resonated with one another were merged, and at the same time knowledge and understanding gained outside design fed into the process, e.g. the study of curatorial practices [8, 2].
All the activities were carried out in groups of mixed expertise, always including in the team CHPs, designers, and technical experts. A number of concepts were generated at each co-design meeting and several were developed into working prototypes. Figure 1 demonstrates the sequence of events throughout the four main consortium project co-design workshops and gives an idea of the scale and variety of the concepts generated and explored. These four consortium workshops were complemented by an array of local co-design activities with the partner museums, which were held in parallel throughout the year. Details of the local activities are discussed in section 4.3.

4. CO-DESIGN ACTIVITIES

During the first year of the project, many different co-design activities were carried out in the context of consortium-wide meetings, as well as several other local events run by specific partners. In the following section, we will outline a number of different approaches and techniques adopted as part of the co-design process. Although the final aim was the same, the examples of activities below are very different: some have technology as a starting point and then move toward deployment in specific cultural heritage contexts; some others start with cultural heritage contexts and move toward developing a technological solution; others instead bring out the same level of detail in discussing both themes simultaneously. The co-generation of concepts of possible interactive installations was the starting point: by understanding the type of interactive installations that heritage professionals want to offer to their visitors, we could begin to envision the type of tools that had to be used to create them. The focus on the cultural heritage professionals, their expertise and attitude to technology, and how they would approach the process of designing and realising an interactive exhibition in an independent way constitutes the core of the project.

4.1 Rapid Physical Prototyping Workshop

The first consortium co-design workshop 1 (as indicated in Figure 1) featured a hands-on workshop for rapid physical prototyping. The goal of this session was for the different partners to experience what could be created by non-technical users with recent DIY technology within a very limited amount of time. For this purpose the .NET Gadgeteer platform was employed as it offers a modular approach where no soldering is needed – sensors and actuators can be plugged into free slots on a mainboard – as well as an IDE (Integrated Development Environment) that abstracts from many low-level details and allows to easily create high level behaviour (Figure 2).

The entire rapid physical prototyping session took place at Sheffield Hallam University over the course of a morning and lasted approximately 4 hours in total. To initiate the session, a hands-on task of building a working prototype was undertaken in small groups to illustrate the functionality of the kit. Each group consisted of 4 – 5 various different members from the consortium partner organisations including CHPs, designers, technical experts
and researchers. Each group included at least one technical expert and one CHP. With a better understanding of what was achievable with the technology, the designers, CHPs and technologists within each group collaborated to devise a scenario for a digital interactive experience in a museum. Laptops with the coding platform were readily available, and three Gadgeteer experts from one of the partner institutions were available to support and help the teams. After the concepts were developed, the hardware composition and coding was supported by the technical experts; in approximately an hour, the groups were able to implement their ideas and have a functioning prototype.

Figure 2. Working with the .NET Gadgeteer graphical user interface for physically connecting the mainboard with modules.

An example of the type of prototype created included an intelligent bag (Figure 3) to be used in the context of a treasure hunt around a museum. While walking around the museum, visitors would collect digitally augmented objects and then put them in the bag; the bag itself would recognize the object and deliver related content to the visitor. This was realised by adding an RFID reader and a small display to the opening of the bag and equipping the artefact replicas with RFID tags.

Figure 3. The intelligent bag for a museum treasure hunt from paper sketch (left) to hardware sketch (right).

4.2 Working with Physical Artefacts
The third consortium co-design workshop as indicated in Figure 1, took a technology free approach, whereby participants worked solely with analogue resources. It was aimed at exploring possible interactions and narratives connected to various existing museum artefacts. Working with real museum artefacts and visual and textual representations of artefacts, the challenge was to imagine and demonstrate simple interactions that could be constructed around physical museum objects, giving consideration to how different interactions could be experienced, what the capabilities and limitations of the objects were and how they related to the museum narratives.

The workshop, which took place over the course of a morning session (approximately 3 hours), was held at one of the consortium partner museums, Museo della Guerra (the War Museum) in Italy. The advantages of hosting the workshop at the museum were the direct access to museum artefacts and the inspirational setting provided by the museum environment, especially effective for those technical and design partners who would not normally work in such a setting. Working in small groups of 4-5 people which featured a mix of CHPs, designers and facilitators, the participants were invited to reflect on questions such as ‘What would I like the object to do?’ and ‘What story would I like the interactions to tell?’ Each group included at least one CHP. Participants shared their ideas on what kind of interactions an object could afford and what sort of narrative they could portray (Figure 4). They then acted out the interactions through show-and-tell and role-playing techniques. By using these specific techniques, the physical dimensions and material capabilities of the objects are scrutinized. Role-playing with the objects also serves to highlight and break down the individual steps involved in the visitor interaction, which is crucial for the participants to understand if the interaction were to be designed for.

Working directly with the physical objects allowed the groups to discuss and identify different types of interactions that would make sense to the CHPs. Considering the sequence of interactions as performed by the visitor and the type of content needed to structure the exhibition narrative were also important aspects of the exercise for the CHPs. In addition, several of the CHPs participating, detailed the design process that they would undertake in designing such an exhibit. This information on the stages of exhibit design provided important input in terms of understanding at what stage they would use the DIY platform.
4.3 Local Co-Design Workshops

In order to address the specific needs of each museum partner, additional co-design activities were held in local settings with these partners. The main goal of these workshops was to understand their specific needs and motivations in using technology as part of their strategy and to make initial ideas on prototyping more specific. Before the co-design sessions, designers and technologists visited each museum and had discussions with the staff to get an understanding of the museum, its audience and its challenges in presenting its collections.

In the case of one partner museum, Museon, a science museum in Den Haag, the Netherlands, their main motivation for using technology in their exhibitions was to be aligned with state-of-the-art developments and to focus on the learning experience. One of the major issues that needed to be addressed, as recognized by the museum staff, was the problem of visitor navigation and how to help the visitor to make sense of all the information and materials on offer within the museum space. Based on the museum visits and internal discussions, sketching and prototyping, the designers explored a number of potential concepts and smart objects, which were introduced to the museums’ CHPs including ‘the compass’ as an object that would guide the visitor through the exhibition (Figure 5). The participants were divided into groups with the goal of letting the curators explore and apply the concepts to their vision, museum, content and audience(s). The brief was: “What kind of experience do you want to create and translate this into a scenario using the concepts and referring to your ‘questions’.”

![Figure 5. Exploring the museums’ collections using the compass prototype.](image)

It was important to organize this type of activity within the actual museum environment, to have room and objects at hand and to be familiar with their routines. It also helped establish a common understanding between design and heritage professionals that can be referred to later on in the project. Important conceptual and practical considerations from the session included the fact that not every object has a story that can be easily made interactive and not all content is easily transferable into visitor friendly formats, as is the case with for example long academic texts. In addition, the social aspect of interaction (i.e. how groups, as opposed to individuals, would interact and behave with the object) needs to be addressed.

An additional local co-design workshop with local partners brought together partners from the two Dutch consortium partner museums (the Allard Pierson Museum in Amsterdam and Museon in Den Haag) alongside a number of local CHPs from outside the consortium, to link content of their choice to the interaction possibilities of prototypes developed as part of the project, and to test and refine this combination. A number of the consortium’s technology experts attended the day long co-design activity, bringing along some of the early project prototypes, while the CHPs brought ideas for exhibits and various types of content. The prototypes that were presented included two wayfinding devices: one wayfinding tool provided tactile feedback in the form of vibrations that could guide visitors to exhibits; and another that took the form of a magnifying glass, that could also be used to guide visitors and provide more information about exhibits.

Another was an interactive plinth (Figure 6); the plinth contained distance sensors on each side and hence information presented about the exhibit could be dynamically updated, depending on the distance between the visitor and the plinth. Another prototype that was presented at the workshop was a wristband; the concept of the wristband was to enable personalised experiences for visitors around the museum. The wristband could be used, for example, as a trigger for delivering personalised content to a visitor, in her native language.

The CHPs working together with the technology experts in small groups of 4-5 people came up with concepts for applying the technological prototypes to the exhibit concepts and then set out to rapid prototype the application of these technologies to the content (Figure 6). By working together in an iterative manner to tweak the content to augment the selected prototypes, this activity allowed both the technical and CHP participants to explore in detail the technology potential for different types of museums and to view it in very practical terms. In having to apply the technology to specific exhibition concepts and content, the prototypes become more nuanced so as to allow for the articulation of a complete story. Exposure to the prototypes stimulated the imagination of the CHPs that, by following the same method, initiated new co-design sessions for more advanced ideas/prototypes.

![Figure 6. Testing (left) and demonstrating (right) the interaction capabilities of the plinth with a whale tooth as an exhibit](image)
• Facilitating a personalised (visitor) experience and allowing visitors to share experiences (e.g. making, collecting, rearranging, redistributing).

5. DISCUSSION
In the previous sections, we have presented examples of some of the different co-design activities that were adopted as part of the meSch project. By adopting such a collaborative and participatory approach, the aim of these co-design activities is to allow the cultural heritage professionals to influence and shape the design of the authoring toolkit that the project will create, enabling them to realise and customise interactive installations at their own cultural heritage institutions and museums. Throughout the course of the first year of the project, a variety of techniques were employed based on the diversity of skills and expertise of the different participants involved and also on the constraints and possibilities regarding the use of technology for the different heritage settings. The outcomes of these activities have helped to generate design concepts and have led to the creation of several working small exhibit prototypes. In broader terms for the research, the co-design activities have also brought about a set of requirements for the DIY toolkit.

The rapid physical prototyping activity was practical in terms of educating the non-technical users of the capabilities offered by pervasive and embedded computing. Showing that there is now the possibility of offering interactive experiences that are embedded and distributed in space and artefacts was key to encouraging the CHPs to think of technology in a fundamentally different way from their current screen-dominated experiences.

The hands-on nature of the rapid physical prototyping was also beneficial to the workshop facilitators, as it provided an initial first-hand insight into the technical expertise of the CHPs who would ultimately be the final users of the intended DIY platform. It was clear that the current level of programming skills needed to realise such a prototype would need to be of a more advanced level than that as demonstrated by any of the CHPs participating in the workshop. Uncovering this information was essential to understand the knowledge and skill gaps that the project needs to address if it is to empower CHPs to create their own interactive exhibits as part of the DIY platform.

Coincidently, it is important to acknowledge that a technology driven activity such as this prototyping session also has its limitations. While demonstrating the technology is valuable in highlighting potential applications, it is imperative that the application of technology does not obscure the ‘real’ needs of CHPs or become applied for the sake of using technology. To this end, a more productive solution would be to begin with a specific museum-related challenge and then to consider how technology could be applied to resolve this specific issue. This scenario requires the CHPs to adopt a much more design-orientated thinking process.

The discussion of possible scenarios of use, as instigated through working directly with the physical artefacts, was constructive in generating questions and much needed debate across the members of the multidisciplinary team. If, on one hand, the designers and technologists were enthusiastic towards the possibilities of digital content being delivered when visitors manipulated an artefact, the cultural heritage professionals, on the other hand, were concerned about the augmented objects being too active and providing too much interaction and possibly distraction, with the risk of not offering a more reflective self-directed exploration. Therefore designing while working directly with the physical artefacts proved to be both stimulating and constraining, while supporting the team to focus the design on potential, but realistic situations.

Working with physical artefacts and re-enacting possible scenarios of use for the smart exhibits, also raises questions of the design communication capabilities of CHPs. If the control over design is really to be handed over and the CHPs are to be empowered to design interactive exhibitions, they need first to be able to communicate their vision. Because of the sequential nature of the intended interactive exhibits, this requires that they be able to communicate interaction concepts, as they would occur over time and spatially. Equipping CHPs with time-based communication techniques - such as storyboarding and stop motion animation - is therefore an important step in empowering them to design and create their own interactive exhibits.

The local co-design workshops allowed for more dedicated time to explore the specific issues concerning the individual cultural heritage participants who represented different kinds of heritage institutions. In turn, this allowed for the development of specific prototypes that the individual cultural heritage participants felt were particularly relevant to their own institutions.

Overall, the co-design activities as employed within the project, have led to the cultural heritage professionals sharing ownership of the concepts and prototypes for interactive exhibitions with the other project partners. As the ultimate goal of our project is that of delivering a toolkit that will enable cultural heritage professionals to design and realise their own interactive exhibitions, it is essential to empower these end users within the design team throughout the process, from exploration to realisation.

6. CONCLUSION
In this paper we have outlined the co-design approach and some of the co-design activities conducted thus far within the collaborative project. The insights on co-design and on the results, issues and challenges arising from it are an illustration of the potential that such an approach to empowering end-users as decision makers in the design process.

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8. REFERENCES


