

cultural heritage.

Experiences, methodologies and tools.



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Doctoral Dissertation  
Doctoral Program in Energy Engineering (31.rd cycle)

# **Toward a more accessible cultural heritage. The application of low impact technology to design a more culturally accessible User Experience.**

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\* \* \* \* \*

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Politecnico di Torino  
April the 29th, 2019

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Turin, April the 29th, 2019

## Summary

This Thesis explores the juxtapositions of three main research fields, such as Design Research, Human-Computer Interaction (HCI) and Cultural Heritage (CH). These domains contribute to defining the core of this research, such as the enhancement of the cultural experience. In doing so, three research questions surfaced from the beginning of this investigation, specifically - *Can we raise awareness toward cultural heritage? Is it possible to improve visitors engagement? Is it possible to engage a vast section of visitors with low impact technology?* The first chapter sketches the introduction and the benefits that may occur, or are already transpiring in the intersection of the three disciplines. In depicting these intersections, it was pivotal to put on evidence the societal and cultural factors that lead to the never old question *Why heritage is important?* And namely, how its evolution and perception shall be kept alive in the present, but most important in the future. But to keep the heritage evolution on a reasonable pace, Design and HCI could be formidable actors in this play. In the second chapter, the literature overview and the analytic review are introduced with the aim of identifying the best practices to adopt preceding the Design experimentations, but also, to depict a scenario of action that is true to the current panorama in Cultural Heritage. In the third chapter is reported the methodology contribution to the Research through Design (RtD) approach in action with qualitative methods from a UX perspective. This chapter anticipates the iteration process that has been vital in carrying on the Design explorations.

In chapter four and five, are shown the two main design explorations that lead to situated applications to investigate the enhancement of the visitor experience. The first situated application has carried indoors, inside the Egyptian Museum in Turin. This project aimed at designing a tool to map visitors behaviour inside the museum, but also, to offer insights on how to avoid hyper-congestion and museum fatigue. In the second exploration, inside the Urban heritage context of the Victorian site of Kensington Gore, a slightly different cultural experience was tested. In this case, the experience was aimed at giving engagement and connection in a more seamless way, by creating a narrative soundscape where people could enjoy insights while roaming freely in the built environment. In the last chapter, are depicted the results of the reflections that lead to an improved design approach, actionable design guidelines and insights for future work.



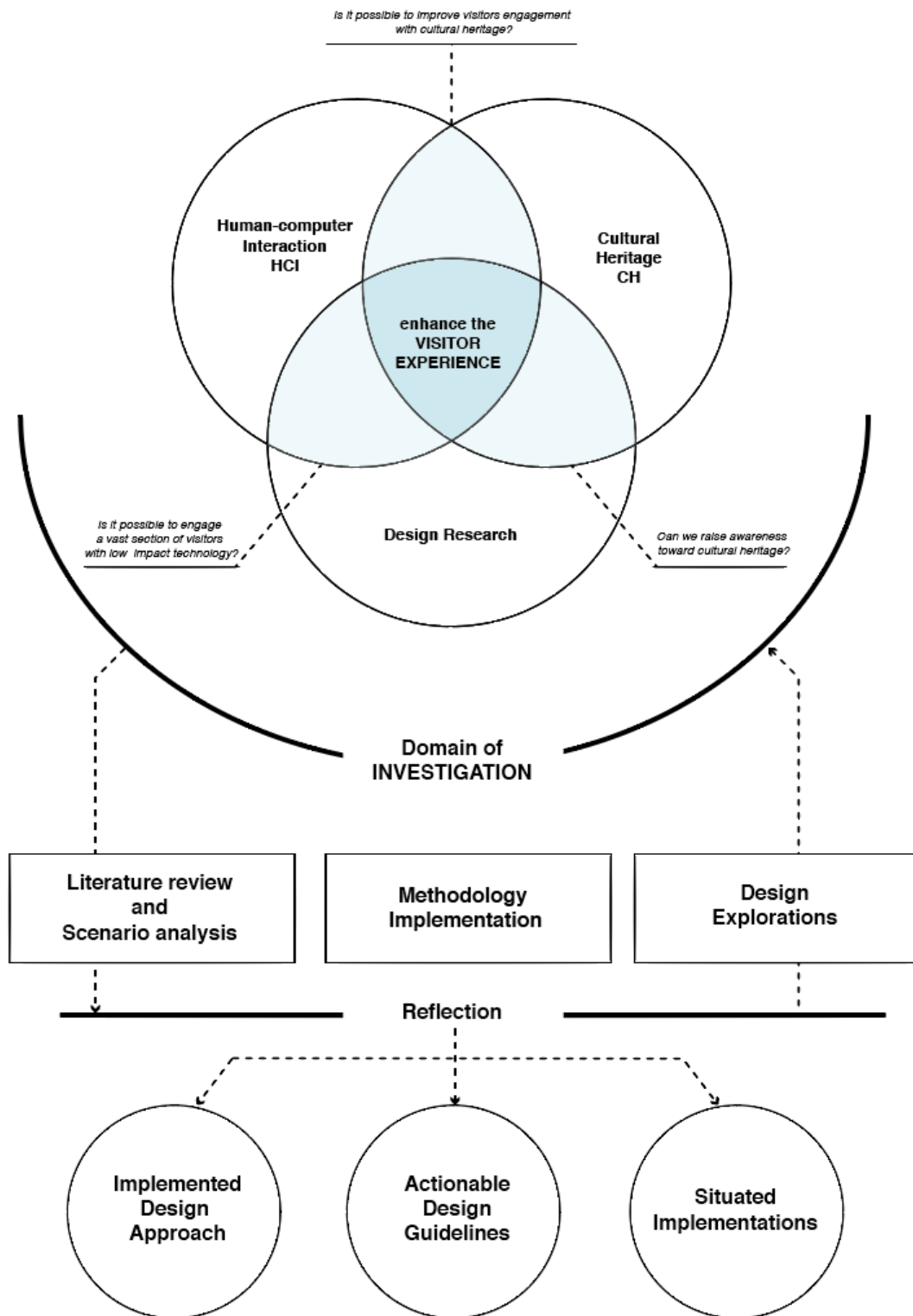


Figure 1: The outline of the research investigation presented in this thesis.



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*The further we go the  
closer we get.*

*But to what?*

*Biology, Ecology, Anthropology,  
Cybernetics, Robotics, Human-computer  
Interaction... What all of these  
disciplines have in common? We thrive  
since the beginning of time to understand  
our humanity, and in all these attempts  
the further we go the closer we get. But  
we get to what? Humans are primarily  
driven by the evolution, it took 55  
millions of years to change from the very  
early primate into the homo sapiens, and  
now a new fast-paced challenge is  
approaching.*

*A challenge called Digital age that  
brought onto the plate millions of  
questions in the last decades, and also,  
inspired this research. This thesis is a  
small contribution to the endless  
investigation toward how we can benefit  
from a digitized world as humans.*

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## Introduction

*What is heritage?*

*And why on earth should we pay attention to it?*

According to Welch [160] “*Heritage is what we have accepted as gifts from those who came before us. Heritage is our inheritance of land, language, ecosystems, knowledge, and culture*”. Heritage is nowadays considered a bond with our past, since the single word itself "heritage", implies a the existence of an asset, that is generally inherited, pre-owned or made from previous generations. The cultural aspect of the heritage represents the inherited bond from our past, defining the public history and the cultural identity[152].

Cultural Heritage is extremely important, but why it considered so precious? According to Bill Bryson in his book titled 'A short story of nearly everything', "*History matters because it reminds us who we are, what we've done and what we might do better*" [19]. History, and in our specific case, cultural heritage (CH) plays a pivotal role in addressing our identity, defining who we are and where we belong. The sense of belonging and identity are in fact part of what leads people to balance decision making in their everyday life with which direction they'd like to go in the future [160].

As stated by Fyona Reynolds [144], the former British National Trust Director-General and the author of '*The Fight for Beauty: Our Path to a Better Future*', people and museum's visitors are increasingly getting more and more passionate about history and heritage, and National Trust memberships have recently reached five million [54, 7]. Therefore cultural heritage (CH) should not be perceived as a dusty and never-changing topic, but something that is continuously discussed and adapted to each individual society. Conferences, research and forums have been held in the last decades with the aim of addressing accessibility and finding out how to enhance the attention toward cultural heritage and history. During one of the various debates related to CH hosted by the University of Sussex at the Royal Institution [144], emerged the need to to put resolution in protecting the heritage but also to localize efforts in making the history more accessible to a wider range of public.

People are getting increasingly more passionate about history, and an increasing avid interest has helped popularise a series of commercial products such as historical TV dramas and documentaries [74, 9] alongside the membership demand of the National Trust and museums [7].

But getting to know better CH to the ones who are not engaged with that is the real challenge, as with many other areas of public concern, is the real challenge. Heritage should be part of to future planning that envisions efforts driven by innovation to set the framework and the road ahead in an iterative discovery [26, 84].

The spotlight on CH should not go unnoticed both in the corridors of power and in our daily life. Recognising the economical importance of quality of life, while adding value to the historic and irreplaceable is the first step in the need for progress. We need to persuade governments, organisations and, above all, people for whom heritage has a big role to play in the economic regeneration of the country. These debates would have been familiar to our predecessors. Have any of us learned enough from history to meet the challenges of the future with a better vision to offer?

## 1.1 Objectives - research questions

We experience culture everywhere, everyday. A much debated question is if culture has this ubiquitous connotation, is the cultural content “fitting the context” and is it possible to enjoy this content? If yes, how?

A substantial inquiry about this topic is how to improve accessibility toward cultural heritage and, make it more manageable for a wider range of audiences to access culture, and make it easier for all the visitors who’d like to engage in a cultural activity by improving accessibility. The access to collections and cultural sites should be considered essential as a means to value and experience culture. Heritage has the power to source individual and group identity and frame our cultural perspectives on a daily basis. According to Welch *“Heritage is a universal process by which humans maintain connections with our pasts, assert our similarities with and differences from one another, and tell our children and other young people what we think is important and deserves to be part of the future”* [160]. Heritage is not something that lies in the background, but instead is a tool that shapes our everyday and gives practical suggestions on what to wear, how to speak, how to behave [129]. Therefore being sensible about our own heritage can be perceived as a tool to grasp and be aware of our daily decisions and life choices, both for communities and individual concern. The research questions that will follow in the news paragraphs have been the developed after the literature review reported in the second chapter of this manuscript.

### 1.1.1 Can we raise awareness toward cultural heritage?

Context awareness is an important research topic in both tourism and hospitality studies, and computer science fields of research [79]. Design could brilliantly promote an interdisciplinary approach to create new connections between people and culture and bridge diverse fields [116]; e.g. people are eager to explore by themselves landmarks and museums to find interesting stories or facts, and increasing their awareness through different perspectives. However, in order to promote this positive tendency, it is necessary to make efforts toward creating a more accessible cultural context. This work of contextualisation could highly benefit from a design approach [140, 27].

#### Is it possible to improve visitors engagement with cultural heritage?

According to Han, to support the community history “*storytelling is as an effective way to increase civic engagement and participation in preserving and developing community heritage*” [55]. Therefore is it possible to infer that a shared knowledge and community history could be helpful in reinforcing the sense of community [55, 156] and creating new connections would help enhance the engagement toward a meaningful contextualization of cultural heritage [140].

#### Is it possible to engage a vast section of visitors with low impact technology?

One goal of this research was to create the chance to engage a wider range of the public in cultural sites, with a minimum cost. However, adopting digital solutions from the information technology could be a delicate issue for cultural institutions, perhaps especially for the institutions most concerned with tangible and monumental cultural heritage, such as museums [153].

On the other hand, since the beginning of public interest in internet communication networks, some cultural institutions started to play an active role in cyberculture [69]. The debate around the digital aspect of museums has been carried primarily around the future role of virtual museums on cultural knowledge, and if heavy digitalization would circumscribe other types of cultural content [85]. To succeed in applying new technological applications in a Cultural Heritage scenario, it is important to highlight the mutual relation between the new media and the environmental context. This awareness can be used as the starting point for experimenting new design methodologies where the environment is considered from the beginning as a modifiable parameter rather than a fixed constraint [69, 41]. In achieving this new awareness it is important to use existing technology, due to its familiarity with the public, that also takes into account a financial aspect, important for a higher adoption rate.



### 1.1.2 Make the intangible tangible, or the opposite?

A restrictive, and somehow narrow vision of culture from the past has been restricting the concept of heritage only to artistic artifacts, however in the last decades a design approach has brought a more inclusive vision of the intangible in the everyday, linking it with landscape, memory and traditions [108]. According to Dal Pozzolo [84], Cultural Heritage has a role in our future, both materially and immaterially. Since it has a double implication, the work of conservation is not meant to be *'a tax that we owe to the past. It does not have to be something onerous, a price to pay from the past that does not produce income for the future. Having a vision for the future on heritage is also an approach to understand in a smart way how this can become a resource for the future, and support a sustainable living.'* In order to shape a more inclusive vision of the future, whilst taking into account a sustainable path, the heritage has to be included, on a tangible and intangible side [96] in a road map toward innovation. The dual nature of the heritage is not to be intended as a cumbersome matter that does not produce any obvious asset, instead as something in which to invest in order to have a clearer vision of the future [26]. With this assumption, in an attempt to define a vision of a sustainable heritage, some variables could be taken into account, such as the identity, the historic dimension, and the cultural diversity [107].

## 1.2 Accessibility and cultural diversity

The famous statement "acting locally, thinking globally" by the Scottish urban planner and social activist Patrick Geddes [21] has never been more coherent with the current effort toward a more accessible culture, that needs to connect local and global communities together for a more sustainable future [89]. Localism is not meant to be a barrier but a bridge, since it's crucial keep the balance right in a national context in terms of making history and heritage accessible and relevant to everyone, without losing integrity [144]. Bridging the gap between local and global helps indeed to bring places to life and to expand the base of what is thought of as heritage: not just museums but also country houses, natural sites, and ultimately urban built environments [54].

### 1.2.1 Understanding cultures

The concept of 'internationalisation of cultures' could nowadays freely transit from being a simply abstract concept to one that is actually applicable. The applicability of this concept resides in the ability of contextualization that could indeed help visitors to view and interact with cultural artefacts and sharing the heritage far beyond national/regional boundaries. With the aim of bridging cultural divides it's possible to create a common ground, where heritage could

become accessible to a wider public, regardless of the country of provenance or the place people live. This attempt should change the perception of heritage artefacts since from a regional and national patrimony there's a place for a common patrimony for all cultures [114]. In this new perspective, it's possible to infer that the concept of cultural diversity itself stems from the opportunity of interacting with multiple cultural artefacts, creating the chance to generate a discussion that bridges an understanding of basic cultural differences providing a significant added value to civics [105]. But what is possible to do effectively and proactively, leading towards a better understanding of cultural diversity? The existing body of research on accessibility toward cultural heritage suggests that ICT could support a sustainable contextualisation. According to Ott and Pozzi [114], *'the adoption of ICT-based tools and methods in the field of Cultural Heritage, helps to reduce cultural barriers'*. The support of digital tools, specifically the inclusion of Human Computer Interaction (HCI) and User Experience (UX) methods, can create environments where related interactive experiences may turn out to be especially enriching for understanding a different culture and context [92].

If the adoption of ICT-based tools and methods in the field of Cultural Heritage Education, helps to avoid or reduce cultural barriers, it can also help to decrease to some extent other kinds of barriers, such as those related to disability. As a matter of fact, due to physical, sensory or cognitive impairments some students may have limited experiences also in the field of Cultural Heritage Education [76] and the use of specific computer-based tools and environments, as well as related interactive learning experiences may turn out to be especially enriching for them.

Thanks to the use of ICT, the accessibility to CH can be enhanced by designing interventions with an access oriented approach which works on different cultural experiences. These experiences could be supported by a plethora of diverse solutions including visual narrations, VR experiences, audio narrative paths, but the common factor is to tailor the most suitable solution to each specific context. In this sense, the design tools are creating an opportunity to provide support to ambitious goals such as creating equal educational opportunities to all people. In fact, new technological tools can be strategic in an inclusive perspective that takes into account an enhanced cultural experience for a more diverse public.

HCI and cognitive psychology could, again, play a pivotal role in making cultural heritage a common patrimony of all people, regardless of their actual provenance, contributing to the recognition of the rights of all visitors to have the same educational opportunities [105].

### **Understanding the implications of cultural diversity in cultural heritage**

According to Paul Ricoeur, it is essential to ask ourselves what cultural diversity means before making any intervention with it, and what we can possibly do with

it [16]. With the aim of providing an understanding of how cultural diversity has a deep significance for CH, we decided to look upon the **relationship between time and culture**. This discussion is meant to be a follow up, from a research path that has started at least three decades ago, and that now is still ongoing patronised by the UNESCO [163]. In our case, we wanted to join this research path from a digital design ground and User Centred (UC) oriented perspective. From an ethnographic side, one distinctive sign of diversity in CH is the concept of time. According to Vinson [107], this concept plays a key role in the tangible expression of culture [152] since the diversity of heritage could be intended as an expression of diversity in terms of different times. Heritage belongs, however, to the historical debate in a wider sense, because it creates ties between management of the past and an understanding of the future.

Heritage plays an active role in supporting social practices, preserving shared memory and envisioning a future where the international community adopts different strategies in creating awareness around culture [107]. With the notion of world heritage, there's an intrinsic principle of collective responsibility for its protection and transmission to future generations. It therefore seemed necessary to distance ourselves from the habitual terms of the discussion for the preservation of heritage in order to address questions of a more historical and design oriented nature [138]. With the aim of providing an understanding of how cultural heritage institutions organise cultural storytelling for the society, accounting for diversity, we should remember, first of all, that the ways of conceptualising time plays a founding role in the tangible expressions of cultures as well as in the systems of intelligibility that allow us to understand and share them. Another aspect of creating awareness towards cultural diversity is to begin to "globalise" local contexts, and make them accessible to a wider public, creating an interesting paradox that possibly can flatten the cultural diversity. According to Vinson [107], to make local contexts more appealing to a wider audience, the concept of universality is accepted as a basis. Universality acknowledges that within each culture specific qualities merit universal recognition, in this sense it is possible to provide a solution to this paradox.

Today, the question addressed to international stakeholders doesn't involve how to *'recognize what makes up the universal'* [153]. Instead, it is a matter of defining the links between cultural expressions which are recognized as universal, with the aim to set out their continuity.

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## Literature overview, speculations and scenario's Analysis

This section of the thesis defines the overview of the state of the art and, more in detail touches sensitive design issues and challenges that are currently defining the scenario. Depicting this scenario has been a complex task since various actors play a leading role in this sense, such as Human-computer Interaction (HCI), Cultural Heritage (CH), sociology, cognitive psychology. In this perspective we adopted the point of view of Research through Design Research (RtD), that allowed us to embrace a User Centred approach with the iterative transliteration of the User Experience (UX) borrowed from the industry. The first part of the analysis that focuses on of the state of the art between HCI and design for Tourism innovation. **It is important to note that the literature review depicted in this chapter has been the basis to pose the research questions reported in Chapter one. The analysis process has been pivotal to establish that awareness and engagement of a vast audience are the key point for increasing accessibility to cultural heritage.**

The systematic literature review that will be introduced in Section 2.5.2 shows how the the concept of User Experience (UX) in Tourism and Hospitality is fairly new in academic research, the data highlights that in particular the keyword 'UX' started to emerge in the literature between 2017 and 2018. This is also a reflection of the evolution of Design in the industry, since, according to Donald Norman, design is getting more and more on the crafting of meaningful experiences rather than designing the object itself [110]. Crafting meaningful experiences is particularly true in the advent of the digital age, since the web gave in the 90's a new opportunities to interact with digital artifacts [42]. Subsequently, after the screening of the literature, this sections presents an overview based on the challenges presented in the scenario of the visitor experience from a Design perspective. In the last part of this section, an array of ten case studies related to narrative experiences in CH are reported, since they acted as a base for the crafting of the design exploration depicted in section ??.

## 2.1 Accessibility and Cultural Heritage - Design challenges in the cultural heritage scenario

In the early generative design process that followed the crafting of the main field studies, many ethical implications have arisen and then revised. Between the revised assumptions, has been necessary to examine and take into account the ones which were mostly fitting the context of use for the case studies that have been subsequently settled up in this research, based on the initial research questions.

A pivotal aspect of this research has been to **enhance the access to cultural sites** for visitors who already approach cultural sites, and for the visitors who are not yet engaged. Accessibility in this research has become a key aspect that we approached from the path of cultural diversity rather than other possible paths that could have been taken into account, such as physical or cognitive impairment. We made a choice of taking this into account in order to make the design process inclusive for the wider range of audience that would be engaged in the cultural storytelling, as stated in the forum for accessibility that took place in Turin in October 2018 [45].

### 2.1.1 Innovation in understanding cultures - technology enhanced accessibility

Innovation has become one of the top priorities for both no-profit and commercial perspectives. Government and local public organisations across Europe [163] are moving toward innovative initiatives in order to be part of the imminent future. Research within the innovation field has been widely debated, and just in the year 2013 over four hundred books have been published on this topics according to Ernst and Esche [36]. **In this research was crucial to identify a chance within the current cultural heritage scenario where different sectors would create together the possibility to support sustainable development for an enhanced cultural accessibility.**

Specifically, it has been challenging to identify how cultural landmarks should improve in order to match seamlessly with the precise visitor target with the help of an enhanced accessibility [36, 35]. And subsequently how cultural institutions could play an active role as a stakeholder in co-creating a sustainable future.

First of all, it is important to understand that new products are not changing the cultural environment in which they will land [61] [113].

Conversely, it is widely known that technology is an actor that can drive the change from a social and political point of view by creating new ways of communication that can lead to a collective call to action [103]. Research points out that in the last decade a more steady awareness around global social issues is gaining its deserved stage, such as global warming, loss of biodiversity and

declining resources. This increased awareness has been possible due to a better technological way to share facts and the adoption of more "multi-dimensional" solutions that merge more field of expertise [46]. This merging of fields is subsequently helping an increasing accessibility . In this research, is pointed out that a winning approach in tackling global issues and raising awareness toward cultural heritage is possible with the help of design. At the same time, according to Meadows [101] is pivotal to visualize who has to take responsibility for the common good, and in which way new stakeholder could take the lead in joint projects [18, 36].

## 2.2 Stakeholders, contexts, and artefacts in a Research through Design approach

Design practice thrives on linking different stakeholder's worlds to align innovation and sustainability agendas. Co-creating a commonly desired future is one of the latest rising opportunities, however, is slowly but steadily gaining attention. According to Meadows and Adams [101] [1], a co-creation of system innovations is seen as a possible way out of the crises and toward the reach of proper cultural awareness [36].

But how design could facilitate collective creativity?

Collective creativity needs to be liberated to do this. How is possible to move toward innovation? Is the mindset of managers and institutional leaders open for change?

Historically, cultural institutions detain a traditional role in a given context, where they act as 'tastemakers' in the field of heritage divulgation. However, recently more and more cultural landmarks are often sponsoring new cultural products ( in music, fine and performative arts...) that are part of a cultural experience that aims to get more close to the audience. These new cultural experiences are helping in *"breaking with previous patterns or formats of culture in order to address contemporary social and political change and prepare society culturally for new social and individual life experiences"* [36].

### Cultural pattern breakers and locality

As an example or early cultural pattern 'breakers' Ernst [36] mentions a very famous, and now historical case, from the Museum of Modern Art (MOMA) in New York. The MOMA started to establish a message of free tolerance after the WWII in the post 1945 culture by creating in partnership with the local municipalities in Germany an exhibit called 'Documenta' [31]. This exhibition has been showcasing paintings considered part of the the so-called degenerate art that have been long



forbidden during the Nazism. Arnold Bode was assigned as artistic director for the first edition in 1945 and, under his guidance the Documenta was a success of participation inviting people from every corner, so a second festival was arranged for 1959. The message conveyed was very strong, since the exhibit was staged on purpose on the ruins of the Museum Fridericianum in order to present a symbolic rising from the ashes of World War II [31]. An other prominent case of cultural pattern breaker is the National Palace Museum in Taipei, which has significantly helped in the dissemination of the art banned during the Chinese regime. Nowadays in Europe there's a crisis toward the cultural heritage, since the main economic resource devolved to dissemination and conservation is related to public funding. In this context is essential to understand the potential of:

- Attracting local communities around collections,
- Attracting visitors from other cities and nations,
- Creating a context of dialogue more efficiently, between the visitors and the artefacts,
- Disseminating cultural content for creating awareness toward the heritage,
- creating a chance for business and social innovation.

Allowing a broader audience to engage with the collections, could bring economic benefits over the medium and long term to the museums, and more at large to the social communities. However, is also true that cultural institutions need to make an effort toward quitting their top-down as 'ivory towers' [36] and contribute to the co-design of a cultural narration, embracing their social responsibility over their place in the cultural elite. In this sense, financial limitation and the increasing cultural diversity are the new a drive to change the mindset of the stakeholders in the cultural narration, that could positively engage a dialogue between the stakeholder with the contribution of the design approach.

### **2.2.1 The Research through Design (RtD) approach for HCI in cultural heritage**

Engaging users in participatory cultural experiences during their day to day life could be cumbersome [123]. This research bends toward social and technological solutions technical solutions that mediate such cultural experiences by a number of interconnected factors concerning the museums, new technological possibilities, and citizens and their evolving practices. In this perspective, the Research through Design approach has been proposed to tackle complex issues [168] [169]. One infamous issue is the lack of ability of engaging users in participatory design during their day to day life, with activities that reveal their

needs in function of product development and planning. Therefore the efforts in designing social and technical solutions that negotiate these issues have been tackled with the Research through Design approach by Korn [78]. In his work, Korn adopts a more comprehensive perspective to perceive a series of entangled and intertwined factors concerning the particular field, such as the cultural heritage and HCI applications.

With the Research through Design approach, he explored design opportunities to infrastructure mobile and ubiquitous solutions. According to Zimmerman [168], the future at which this approach points, is a scenario where proactive citizens are more actively involved in the design of their direct living environment.

Research through design seeks to integrate design practice in daily life, and interaction designers thrive to develop more up to date, and efficient methods.

Central to this approach is the will to solve real problems, that is often opposed to a more commercial point of view, that defines a favored state of the art develops products toward that. The risk is that the products developed toward a "preferred state of the art", created with little research could lead to the creation of meaningless products and experiences.

the RtD approach showed by Zimmerman defines that:

Interaction design researchers combine the theoretical models and theories from behavioral psychology with knowledge from engineering, leading to new opportunities. Design researchers ground their explorations from the knowledge generated by anthropologists and design researchers, delivering the upfront analysis in a design project.

Within an active method of creating, iterating, and questioning potential solutions, design researchers constantly scrape the research questions as they attempt to make the product development. The final output of this pursuit is a real problem, that often frames an articulated scenario, with a series of artifacts models, prototypes, products, and documentation of the design process [168].

In this research approach, the pursuit of a defined scenario is supported by UX methods. The design artifacts presented are relevant results that embody theory and technical opportunities working toward a real problem [168].

These opportunities grow as design patterns that may carry research findings to other project and researchers. These opportunities could be interpreted as a suggestion for an optimal research environment that is open for analysis, interpretation, and evaluation, or as a stating opportunity that creates a new place for design. New places for design allow other researchers to produce artifacts that can better define the relevant phenomena in the new spaces of action [169]. With the purpose of appraising an addition made through research through design, Zimmerman et al. [170] suggest a set of guidelines. These guidelines are comprehensive of "*extensive documentation of the design process; meaningful innovation through original integration of theory, technology, user need, and context; relevance to the real world; and extensibility of the outcomes*" [170, 43].

## 2.3 The visitor experience and disruption issues

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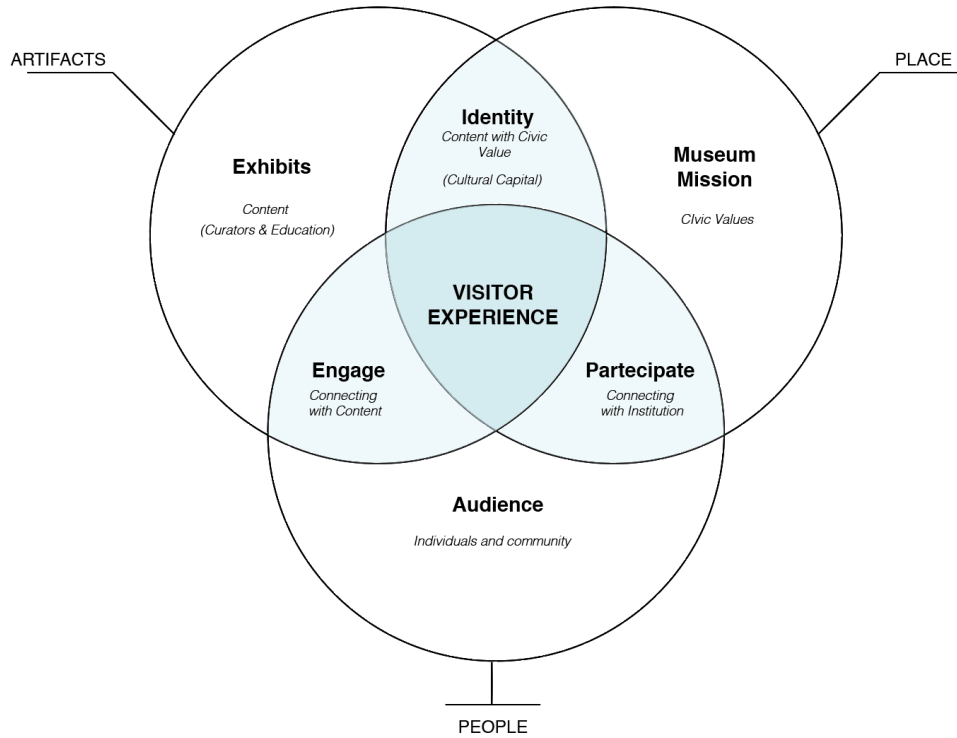


Figure 2.1: The Falk's diagram [38] illustrates how visitor experience is the intersection of exhibits (things), visitors (people), and museum (place).

Central to the entire discipline of visitor studies is the concept of museum experience. This experience *“begins before the visit to the museum, includes experiences within the museum (interactions with staff and members of one’s own group, as well as with other visitors, exhibitions, interpretive materials, and programs), and continues long after the person leaves the museum”* [38][72]. Furthermore, the museum experience is something that can be designed and enhanced [38] with the help of technology[3] in order to let the visitor learn from the artefacts. According to King and Lord [75] *“museum learning is a voluntary, informal activity. The voluntary nature of the experience has much to do with deciding what to see within the museum space. Navigation is agency; people decide*

<sup>1</sup>part of this section is published in: Khan, Sara, et al. "Exploring new functionalities in cultural heritage spaces-designing different museum trails with low cost technologies." In: DS92: Proceedings of the DESIGN 2018 15th International Design Conference. 2018. p. 2251-2262.

*with their feet. The initial requirement for successful museum learning, whether online or onsite, is clear navigation.”*

Museums often have to respond to visitors’ basic needs of locating themselves into an unknown space. These needs can span from finding the toilet or the café shop to specifically looking for a showcase or the newest exhibition [38], and for this reason, a tool to navigate inside the museum’s space should fit the users needs with a high level of personalization [3]. A good level of personalization can enhance the museum experience by tackling the physical and cognitive issues that could disrupt the visit, such as hyper-congestion and museum fatigue. In addition, the museum visitors can belong to different target and age range, for this reason, it can be helpful to adapt different features and contents for every user profile [126].

The museum experience is mostly learning oriented and the leisure factor plays an important role in terms of learning[161]. To allow visitors to enjoy leisure time inside the museum it’s crucial to understand how people interact with the collections and the showcases. The ‘stress as a human factor’ can influence the perception of the museums’ artefacts and could be detrimental to the learning experience that these cultural institutions usually offer. The stress variable can be composed of two main issues: hyper-congestion and museum fatigue. These two issues related to visitor studies have received considerable critical attention in recent times [38]. In this research, will be depicted first a scenario describing the context of a Visitor Experience, that is composed by a series of factors which are directly dictating the quality of the experience. According to Falk [38], the Visitor experience is composed by three main categories, as shown in Fig. 2.1. These three categories are:

- **Artifacts**, composed by the collections and the exhibits, which are strictly related to the content created by curators for dissemination and educational purpose;
- **Place**, depicted as the site itself, but also the immaterial Museum Mission and related civic values;
- **People**, the Audience of individuals and communities at large that engage with the cultural content in a social way.

But, the categories mentioned above, are not intended to be seen separately, conversely they have to be perceived as bigger themes from which intersections are spurring other 3 categories respectively:

- **Identity**, which includes the civic values and the Cultural Capital at large;
- **Participation**, which includes all the actions that focus on connecting the audience and the cultural institutions;
- **Engagement**, a theme that will be fully analysed in this thesis, both in this chapter, and furthermore in the cultural narratives part.

In the following sections, from Sect. 2.3.1 to Sect. 2.3.6 the variables which are disrupting the Visitor Experience will be analysed in function of creating a scenario for improving accessibility and engagement to cultural content.

### 2.3.1 The paradigm shift in cultural heritage institutions

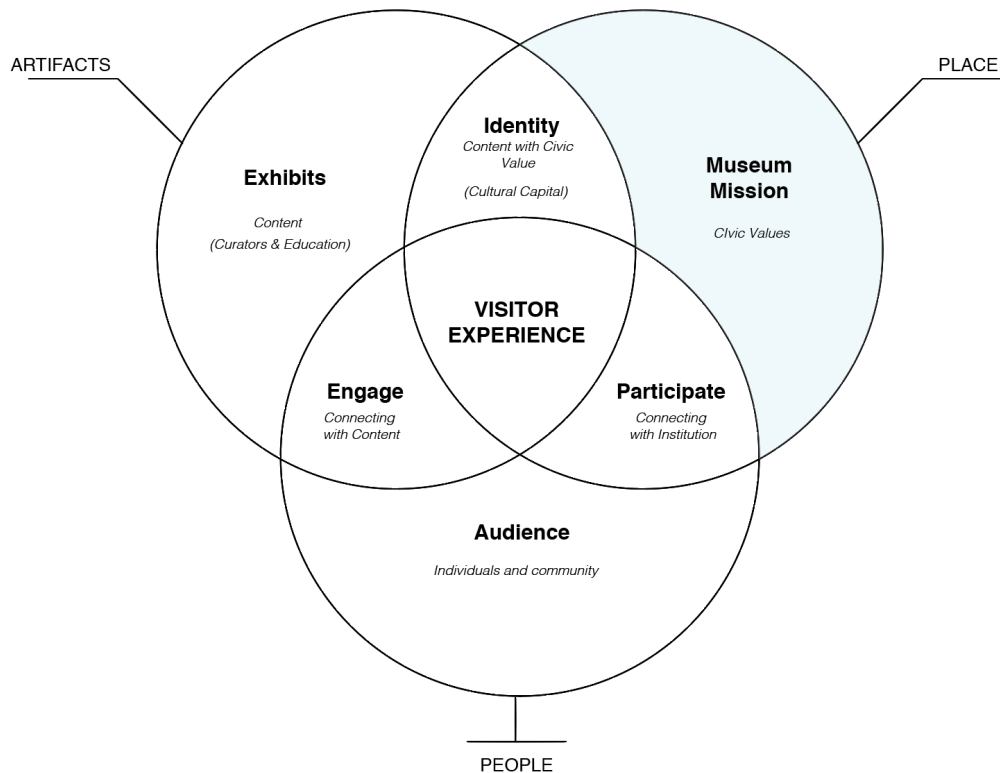


Figure 2.2: Cultural landmarks gradually started to change their mission, from a mere educational establishment they started to introduce themselves inside a cultural context, strictly bound to the local community they aim to become part of it.

In recent years, there has been an increasing interest in the ‘Heritage Industry’ [156] since as stated in section 1.2 cultural diversity creates chances to find common ground in new ways of understanding cultures. This increasing interest has been relevant especially in the last two decades, where different activities related to CH are reflecting the great diversity in terms of social engagement and the form it has as a reflection on a global scenario [156]. Every context is unique but in some cases CH is taken into account toward a very leisure oriented approach that is not mentioned to be condemned in his cultural

significance, but instead should highlight a chance in to trace “*a segment of the personal daily schedule that is dedicated to non-work activity and recreation*” [156].

This segment in the daily schedule is an important chance due to the real value of CH, that should be placed in the everyday and take an occasion to engage a constructive social dialogue between communities.

According to Loomis [91], **museums gradually changed their mission**, from a mere educational establishment they started to introduce themselves inside a cultural context, strictly bound to the local community they aim to become part of it. This community can be strongly rooted to the territory and the town where the Museum is established but could be also have an international exposure. This kind of exposure is nowadays reached thorough a deep social media interaction, that can put each museum in closer contact with the visitor’s need, but also helping an effective networking with other museum institutions. The transformation and the development of a new, and wider, museum visitor community has forced the museums establishment to rethink their vision and mission, in order to appeal to the public and preserve their collection. To accomplish the new mission museums have started to invest time and effort into the preservation of the cultural heritage and the development of new methods of engagement in order to make the museum collections more appealing.

The design can play a helpful role in this intent, because the aim is to enlarge the accessibility to a wider range of public, it’s vital to think about the usability of each solution [70]. As Lidwell says “*Objects and environments should be designed to be usable, without modification, by as many people as possible*” [86]. The principle of accessibility claims that any design’s product has to be accessible to people with diverse abilities, with any particular adaptation. This claim will be notably helpful in our case studies in the next chapters, where visitors who will interact with our design products will be part from diverse backgrounds and cultures. <sup>2</sup>.

### 2.3.2 The complex cultural identity of museums - cultural heritage institutions today and design challenges

A museum or a cultural landmark could be considered as a working group of several active parties that are dedicated to the achievement of objectives aimed at a common goal [2]. The most obvious goal is the dissemination of the cultural contents of its collections, while other targets are related to the preservation of the heritage itself on the behalf of the community, which involves both the duty of

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<sup>2</sup>part of this section is published in: "Interaction design applications for museum spaces. New exhibit paths driven by a Bluetooth sensor’s system" - S. Khan, C. Germak, The Design Journal 20 (sup1), S3914-S3924

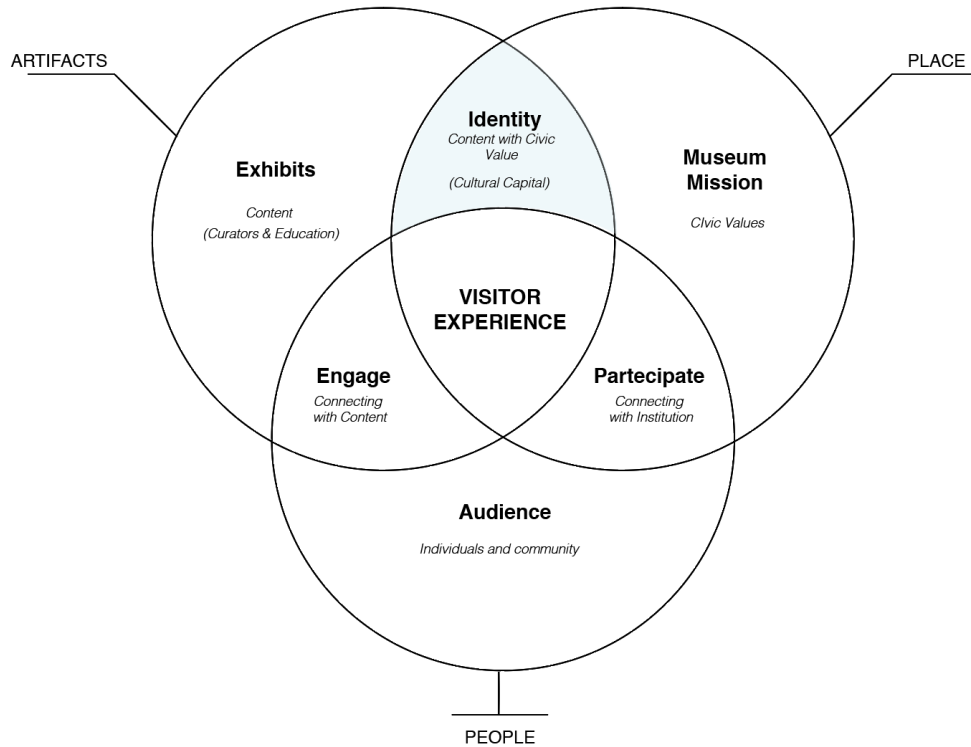


Figure 2.3: The cultural landmarks' identity is facing a huge makeover, since it's crucial to understand how to still deliver a good quality cultural content while appealing to a wider range of visitors.

protecting the artefacts but also the honour of being an institution holding cultural contents [2]. Museums are also acting in response to the challenges of adapting to an ever-changing environment in their pursuit to remain relevant to their visitors, communities and stakeholders. In fact, according to Bearman and Wittlin [161], new and emerging technological opportunities can support CH institutions to adapt to this new environment[8]. The common trend is that social institutions are evolving, as the societal cloth is continuously changing. Therefore these cultural institutions, to remain relevant and to fit into the experiences and needs of the societies that support them, have a constant call to change their focus and methods [62]. The drive for change is often triggered by diverse sources, such as demographics, social issues, leisure activities trends and, political pressures. For a number of years cultural landmarks have encountered new challenges applied to public organisations, such as diverse aesthetic tendencies, improved liability, and novel technology pathways[95]. Thriving cultural landmarks started to answer to these and other tenuous changes in their societal context in looking for effective approaches to lure more visitors, attract funds, increase collections and hire more staff.

Recently, a considerable literature has grown up around the theme of technological solutions for CH, and how informatics has facilitated cultural landmarks to significantly transform their way of communicating internally and to the public over the past several decades [104].

Nowadays a cultural institution without a digitalized database collection and a Web appearance will be hardly taken into account as an expert in the field. Despite not all institutions are using online access at their full capacity. Museum professionals strive to make use of informatics to achieve their purposes, and it has been proved that human computer interaction (HCI) systems could fully support these intents []. Museum management is thriving to be in a position to anticipate new developments when planning for new buildings, future budgets, hiring staff or seeking funding. CH authorities are actively searching for "ways to assess the best current technologies for specific institutional purposes and to anticipate future opportunities" [8]. Favourably, design research is actively investigating new ways to enhance access to cultural heritage with digital solutions and is exploring systematically what has been done and what might be feasible. HCI is alongside design practices proposing approaches to various new technologies could help some museums to achieve their objectives. The multidisciplinary nature of design is of great significance, in that it needs an increased scope alongside research effort in understanding the users' needs.

### 2.3.3 Branding the culture

Engaging visitors with cultural content is undoubtedly challenging [68]. However, making people connecting with artifacts it's the ultimate way to convey the cultural message and realize one of the most prominent goal of cultural landmarks: make the collections readable and understandable to the greater public. This issue is represented equally in museums, urban and natural heritage. In addition, the urban heritage is represented by places linked to the built environment that are already iconic, but not really representative of all the sides and transliterations of a culturally diverse audience[152]. This happens also on a smaller scale in the museum environment, e.g. the Mona Lisa in the Louvre museum is one of the most famous masterpieces but most of the time people are focusing just on this artwork, easily forgetting to pay attention to the surroundings. According to a study published by the MIT Senseable Lab[167], most of the time visitors overlook the very famous Giotto's display just in front of da Vinci's masterpiece. The reason why is that anyone who visits the museum feels the need to snap a picture of the Mona Lisa, as a means to underline the "*Lowvre museum experience,*" and "*to bring back home the proof of having been there,*" such as a small souvenir. Therefore collecting samples of the museum/cultural experience is a recurring action in tourist and museum visitors[155]. The cultural landmarks, therefore, are becoming brands and



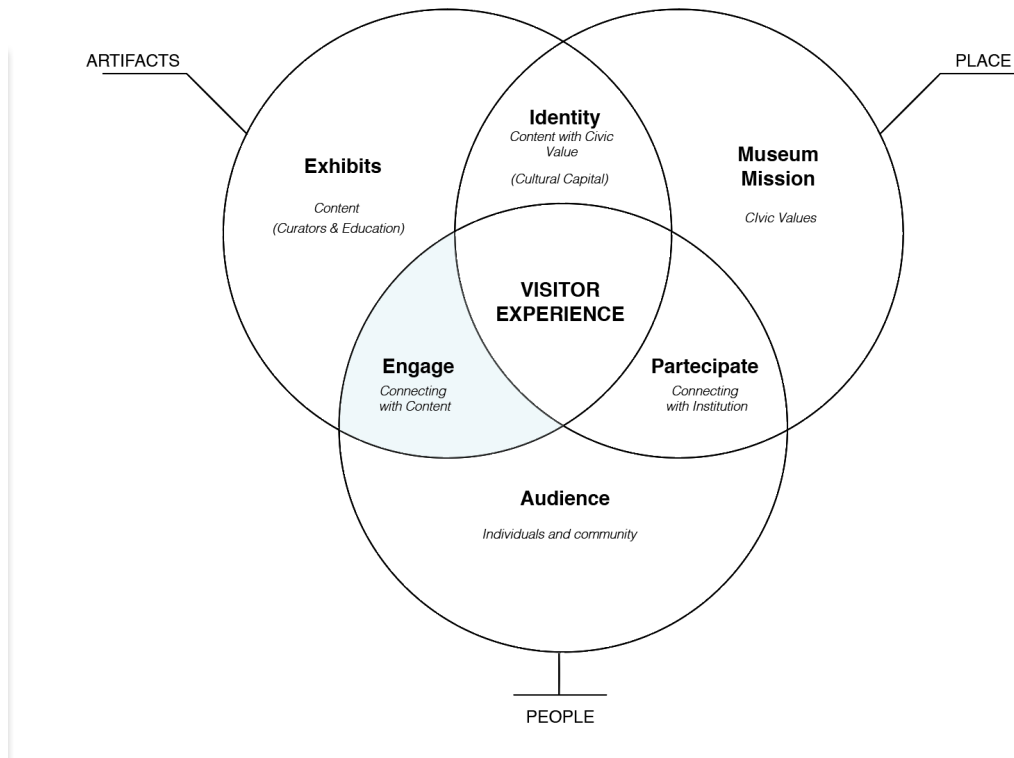


Figure 2.4: In order to reach a better visibility, cultural landmark need to be understood by a wider range range of visitors. As a brand does, engaging with a cultural brand is essential to create a context for connecting visitors with the artifacts.

reaching a wider audience. But to reach a better visibility they need to be understood by a wider range range of visitors. The key aspect in being understood by the audience is to find a common root between different cultures, and globalize what at the moment is only locally known[155]. The challenge is to contextualize masterpiece, cultural landmarks and pieces of the built environment. Rarely cultural artifacts are located where most people live, "here". Too often they are — it seems almost by definition somewhere else, "there". People might visit them on holiday, but this type of heritage is not part of the everyday landscape of their normal lives. If heritage is thus defined as elsewhere, there is a risk that it will unintentionally become an instrument of exclusion. It can become an instrument of inclusion and commonality if it is defined contextually as local, lived-in, ordinary, and if it is recognised as an element of both shared identity and differentiation [162]. Contemporary heritage studies are the results of ongoing interactions in the lived world of ordinary people [giaccardi].

### 2.3.4 The decision making and the guilt of the ‘right choice’

exhibits

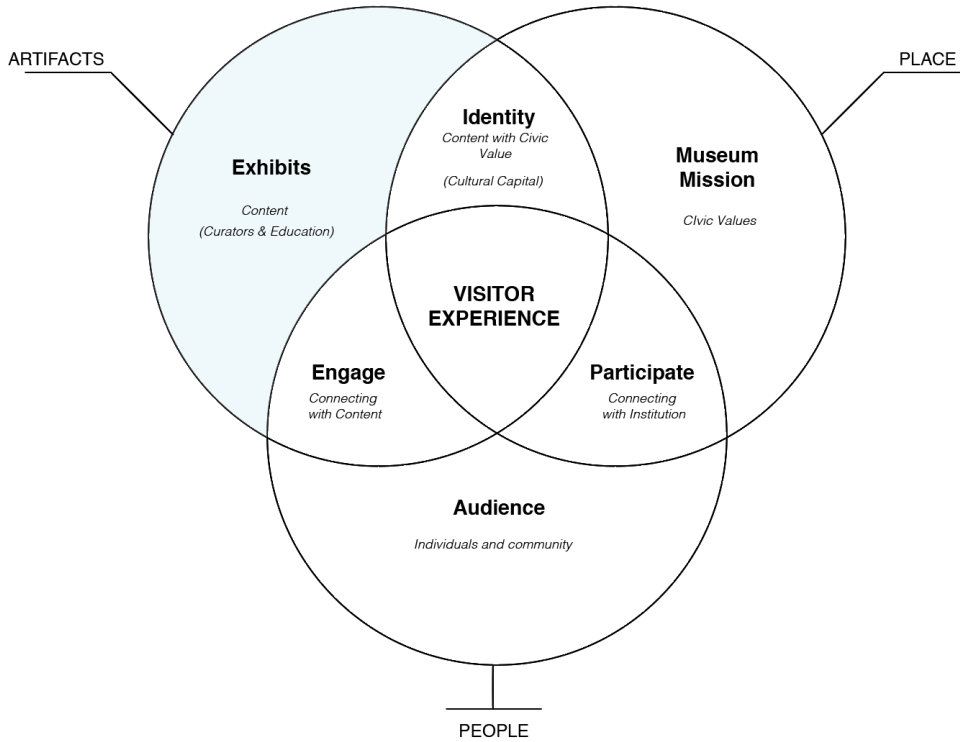


Figure 2.5: The Physical space in the museum is a key factor that influences the Visitor Experience. The design of exhibits and the content delivery is highly dependable on how well people can orientate inside the museum and accessing to the information they need.

The Physical context in cultural landmark is a factor that highly influences the perception of the cultural content [30]. Therefore designing the exhibits and the museum’s spaces just according to the content is not enough to make a meaningful visitor experience [146]. In order to craft an impactful visitor experience is essential to take into account human factors and consequential issues for conveying a deep educational content. The physical context of a museum/cultural landmark starts at home with leaflets or websites of the museums, and goes on site toward the real physical orientation in the space [109]. Many factors could affect the visit, but one in particular does on a deep level. The key aspect that profoundly disrupts the visitor experience is **the decision-making process** that most people encounter in large scale cultural landmark’s visit. **Where shall I go? What shall I visit first? Should I book a tour with a museum guide or roam around the showcases by myself? Or if I visit the museum with a professional**

**guide, is this going to be worth my money and time?** Concerning this issue, Schwartz [4] underlines that, as alternatives are piled up within a specific choice, various intricacies might emerge [132]. First of all, gathering the proper amount of information before making a choice is notoriously painstakingly and time-consuming. Later on, as the range of options available increases, users' standards for "*what is an acceptable outcome*" evolve too [132]. In addition, people might start to feel a sense of guilt since they assume that any flawed outcome is their direct fault: with so many alternatives, there's no excuse for making a bad choice [56]. According to Hanoch, there's a hidden irony in the last stance, since if the variety of options increases, it becomes critical to identify the most suitable option for the specific situation. These issues are very noticeably appearing in contemporary western societies '*where people are overwhelmed by almost unlimited options in all domains of life*' [57].

Numerous investigations conducted by Bellah in the field of applied sociology [60] resulted in highlighting that people frequently appear hesitant and nervous about their life decisions because it's unclear the path to make the right choice between the array of the given ones. This "excess of freedom" has resulted in a drastic rise in people's dissatisfaction with the user experience, since according to Schwartz, this kind of dissatisfaction could even trigger a depressive clinical state [131, 82].

### 2.3.5 The Visitor fatigue and Hyper-congestion.

3

Promoting inclusivity is the ultimate goal to achieve a significant visitor experience [152]. Studies over the past two decades have provided important information on how the global impact of the digital revolution is influencing the museum and visitor studies.

Museum fatigue [50] and hyper-congestion have recently become a key issue, and they have acquired more resonance [15] in contemporary times.

Physical and cognitive issues related to the museum experience started to be increasingly relevant because of the change of paradigm of the museum as an institution. Therefore, museums have gradually shifted their main educational role to a leisure oriented duty: they have become a place to experience the collections where it's possible to increase the personal knowledge by a specific exhibit's storytelling. As a result of the museum's social role shift, this cultural institution started to appeal to a more varied type of visitor, ranging from

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<sup>3</sup>part of this section is published in: "Interaction design applications for museum spaces. New exhibit paths driven by a Bluetooth sensor's system" - S. Khan, C. Germak, The Design Journal 20 (sup1), S3914-S3924

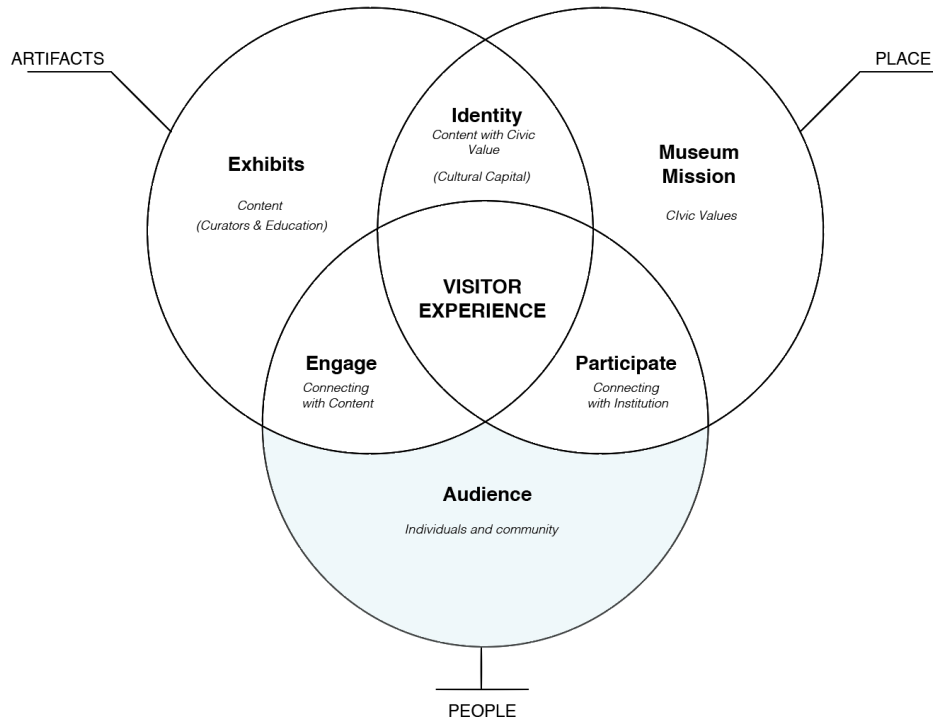


Figure 2.6: The audience cognitive attention is greatly influenced by physical obstacles that disrupt the visitor experience. Visit physical disruption such as Hyper-congestion and Museum fatigue could greatly affect the quality of the visit.

connoisseurs of the collection to those who face the artefacts for the first time [70].

Hyper-congestion is the phenomena that happens anytime the amount of visitors exceeds the physical available space. This is very typical of large scale museums such as the Louvre [167], and it has been partially observed in a study conducted by the Seanslebe lab at the MIT [167]. Whenever the capacity of the physical space inside the museum is compromised, the quality of the visit obviously decreases. Overcrowding means above all dealing with disturbance derived from other visitors. Museum fatigue instead has been long studied, since Gilman [50] started to investigate the effect of physical exhaustion in museum visitors in the roaring twenties. Gilman observed that physical exhaustion, deeply impacted any cognitive function necessary to connect with the artifacts. In fact his studies started to shed light on how much visitor could grasp from the cultural content, if they were effectively tired. This tiredness, or fatigue for Gilman and Falk after him, is triggered by a series of factors that generate stress in the users, such as the decision making issues 2.3.4 and the contextualisation of the artifacts 2.3.3, mentioned in the sections before.

In addition, other findings from Bollo, Dal Pozzolo, 2005 [14] show that the

less the visitors know a priori about the museum collection, the more their behaviour and learning experience can be disrupted by the spatial settings of the exhibits. Hence, the visitors can explore the collections freely, but they can also ignore specific objects or showcases inside the space, neglecting disclosure from the narration proposed by the curators <sup>4</sup>. Furthermore, visitors often ignore the reasons that lead the museum's professionals to chose a specific arrangement for the exhibit, and why specific objects are shown in the display since the public often ignore the curator taxonomy and the selection criteria used to give a hierarchy to the artefacts [128]. For this reason, it's important to focus on how to enhance the museum signage, test its efficiency and narrative power, and where possible, strengthen it with some adjustments with low cost technology [120].

According to Partarakis et al. [115]: "*The global impact of the digital revolution in the cultural sector worldwide brings about the need to ensure the accessibility of physical exhibits', interactive digital exhibits, digital media and digital content for disabled people.*" This research addresses the accessibility of cultural heritage resources, and the need for a new approach to accessible user interaction with cultural heritage exhibits.

Museum fatigue [50] and hyper-congestion have recently become a key issue, and they have acquired more resonance [15] in contemporary times. These matters have become increasingly important due to the changing role of the museum: from a more educational appearance lately it has started to turn into a place of leisure in which to spend quality free time. The evolution of the museum's social role has started to engage a wider range of the public [70].

### 2.3.6 Time and Space - a matter of perception

Participation is a great deal for the visitor experience, but not always is achieved. In order to optimize it and create the environment for this to happen, a proper contextualization of the artifacts has to be done. Contextualisation is possible with the proper perception of the historical context of the objects and the place where they have been found, therefore time and space are a pivotal factors in the experience.

As we started to introduce in section 1.2.1, the relation between time and cultural heritage is pivotal in assessing its significance for the larger public, specifically in its role toward in cultural diversity. In the field of museum studies, the connection with time is strictly joined to intellectual paradigms for the construction of knowledge [152] and to the cultural association's ability to formally acknowledge and validate part of its institutional objectives.

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<sup>4</sup>part of this section is published in: Khan, Sara, et al. "Exploring new functionalities in cultural heritage spaces-designing different museum trails with low cost technologies." In: DS92: Proceedings of the DESIGN 2018 15th International Design Conference. 2018. p. 2251-2262.

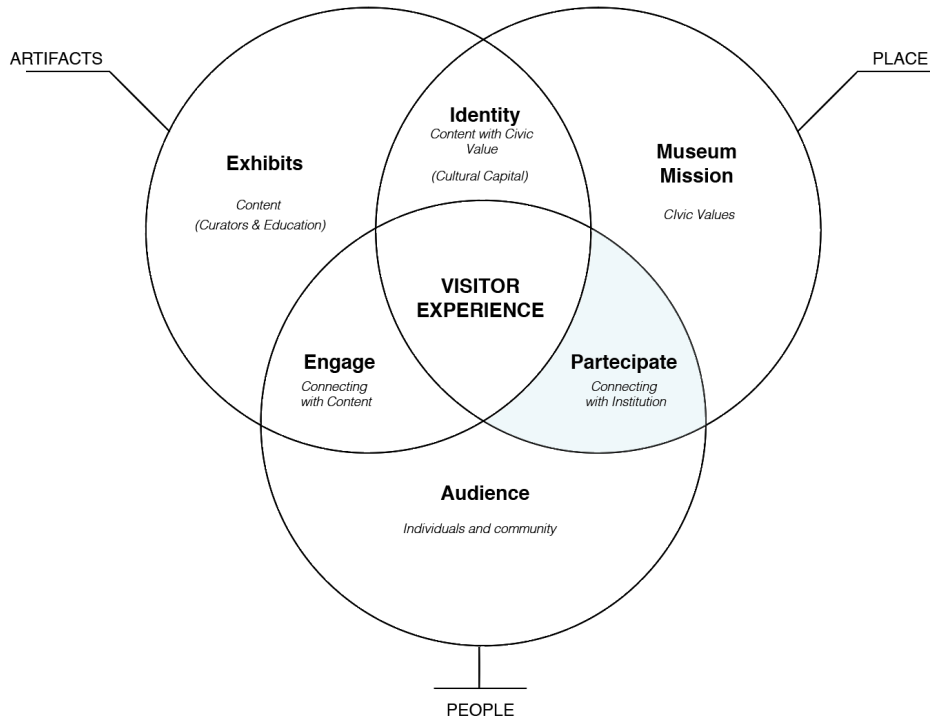


Figure 2.7: Participation is a key factor that implements the visitor experience. Contextualizing the artifacts is a significant step in order to make cultural content more accessible.

In the UNESCO report edited by Vinson [152], it is underlined how the contemporary reflection on the dimensions of time, and its intelligibility through a proportion of narrative storytelling supported by exhibitions, collections and institutions takes place in various paths. The historian Romilla Thapar [145], suggests that the feasibility of understanding time lays on different levels in Indian culture. She explains how the narration of the intersections between great mythological cycles can enable perception of the past in the who is encountering as a recipient the historical data. [152] [145]. An other historian, Francois Hartog, instead supports the idea of the co-existence of different regimes of history and memory [58]. Hartog proposes the feasibility of a new perception of history that is directed on how to contextualize the past in the present, saying that one indicator of this new perception has evidence in the current heritage craze and revival for everything related to an historic asset [152] [58].

## 2.4 A cognitive perspective: UX design to bridge cognitive psychology and HCI for a better accessibility

The user experience (UX) toward cultural heritage has been long analysed in museum studies disciplines. In fact, Free-choice leisure and learning behavior have been key aspect of the museum experience, and at large of cultural experience[12]. Over the past 30 years, John Falk and his collaborator Lynn Dierking, have been investigating the visitor experience, and in this thesis is going to be analysed which kind of contribution cognitive psychology could make to the field of human-computer interaction (HCI). In 1993 Draper [33] started to debate about this topic, but in 1996 Green [53] finally brushed and defined a more viable path to follow, presenting a position in a debate that has been *'fuelled by unrealistic assertion whether cognitive psychology can supply everything that HCI needs, or that cognitive psychology is irrelevant to HCI'* [53]. Instead a more reasonable approach is to broaden the paths of research contributing to outline where cognitive psychology can achieve the most well suited improvement for a better accessibility of cultural goods. An other issue that will benefit from UX approach to HCI is the implementations to the human factors (HF). Usually human factors integration in the design process is something perceived as a task analyses to be fed into these specifications related to ergonomics. But As stressed by Bannon [6], HF should be taken into consideration from the concept phase of each project since *'the role of HF or HCI in system design today should be more fluid and pragmatic'* [5]. Green pointed out that Human factors (HF), represented by psychology and ergonomics, even though they play a pivoting role in computer system design, are often overlooked [53] [22]. This is true if we consider that Bannon [5] suggests other perspectives will help in understanding the connection among people, technology, work requirements, and managing requirements, where Human Factors are real users, actors in specific situations. This is a big contribution in HCI research and cognitive Psychology. In addition, just focus the attention on the users not enough, since users are not simply passive subjects of study. People are, or can grow into active agents [6]. Carroll at al.[22] explain very clearly in their research how users have the desire to perform a task, and at the same time to understand the context. People are willing to go forward in understanding how to use an interface by themselves. If the interface is acting unclearly, users will try to make up an explanation for its behaviour, in the attempt to make sense of their surrounding world. Seeking for meaning in the interaction with digital artefacts is the key that triggers the User Experience Design, since this discipline is moved by the purpose of creating meaningful experiences for the users.

In conclusion it's possible to understand the transition from cognitive psychology, human factors to bridge gaps in HCI: an attentive UX planning could take into account meaningful variables from the conceptual stage of the project till the end [11].

## 2.5 To tell a story: a narrative experience of contextualisation for cultural accessibility

Nowadays the efficacy of museum's educational approach resides in the ability to contextualize its collections to a wider audience [25]. Museology is a powerful tool to recreate ancient contexts and make them understandable to the visitors by creating a narrative experience for an enhanced accessibility. But following what has been mentioned in section 2.3.3 and 2.3.6 museums and more generally speaking, cultural landmarks are becoming increasingly a brand themselves, that promotes cultural experiences based on different levels of narrations. Museology professionals are facing increasing challenges in Contextualizing artifacts. This contextualisation process also means setting the artefacts in a context of apolitical and public imagery that is far from being static, with the help of different tools and skills. Partially because the natural evolution of the collections and the art is mirrored by socio-economical developments [102], but also because the need to attract new visitors is linked to the self preservation of the CH institutions.

Contextualisation is a pivotal point around which visitors participation could shape a better cultural experience. Especially nowadays, where cultural landmarks are turning into hybrid spaces, where digital information accompanies tangible artefacts [25] for enhanced accessibility. In this given scenario, the future digital solutions are a new actor that supports methodologies to enhance cultural accessibility and creating meaningful experiences. According to Dal Falco and Vassos (2017) *"Not only is the goal to convey stories hidden inside artefacts, as well as items or objects connected to them, but it is also to pave the way for the creation of new ones through an interactive museum experience that continues after the museum visit ends. Social sharing, in particular, can greatly increase the value of dissemination"* [25].

### 2.5.1 Personalisation of the cultural experience - issues and challenges for better accessibility

According to Ardissono [3], personalisation can greatly enhance the cultural experience since it's composed by different aspects. These aspects could take into account social/cultural values, physical condition of the visitor and identity



related variables. In addition *visitors behaviour may not remain consistent during the visit and this may require ongoing adaptation*" [3]. However, the most effective personalisation goes unnoticed by the users. The technology is perceived by the users only when it doesn't work as expected [32]. The issue about merging technological and analog solution to ease the visitor experience, could be sourced in a combined framework between a Research through Design approach and UX methods, that will be pivotal in crafting a personalized meaningful user experience. In addition, personalisation could help in shedding light on when is strictly necessary to apply digital solutions, and when it could be avoided in favour of other kind of narrations. In this research however, has been stated that museum visitors can belong to different target and age range and, for this reason it can be helpful to adapt different features and contents, since according to Rubino [126] *"one of the most adaptive technologies at the moment is the use of the mobile Apps as a tour guide"*. But introducing new solutions in cultural landmark is troublesome, and personalisation alongside a co-design approach could really minimize the use of unnecessary digital tools and focus on the user needs, since users should be taken into account in order contribute and reinvent their personal knowledge and explore new ideas. This process can generate valuable user generated content and contribute to a transformational experience [139]. Transformational experience are vital to both monitor the users' understanding of the collections and to shape their knowledge around cultural landmarks by giving feedbacks to the designers. Transformative ways of transmitting knowledge as opportunities for individuals to invent knowledge, transform what they have encountered in the past, and perhaps eventually contribute to new ideas and concepts. Visitors can contribute positively to invent knowledge while taking into account their personal heritage, contributing to create new contents and knowledge [139] [32].

### **2.5.2 Design appearance in HCI: features and semantic analytic review**

In this section, a pool of selected papers have been listed for further research in this thesis, it's honest to say that they don't represent the whole HCI field of application, but they give an overview on the current crossover trend of Design contributions in CH.

This review took into consideration 173 articles that emerged from annual conferences and journal publications between 2015 and 2018 sourced online from ACM Digital Library, Scopus, Science Direct, IEEE Digital Library and Springer Link. The keywords used for this search at first were: (visitor experience) AND (digital technologies) AND (cultural heritage). Later on, to expand a bit more the view, other keywords such as (Tourism) AND (User Experience). The time gap has been taken on purpose on the larger side because

there was an aim to verify the evolution of the level of engagement of the visitors from a mere interaction with the artefacts to a proper user experience.

The initial research questions summed up in table 2.1 that helped to define this pool have been inspired by the review performed by Shah et al. [137], where qualitative analysis questions that were asked while analyzing the articles to produce data findings

Table 2.1: These set of question have been used in order to support and select the pool of 173 papers from which the scenario for this research has emerged.

Question	Answer
Q1: Was the article about digital technology in CH?	Yes/No
Q2: Was user experience or HCI mentioned in the paper?	Yes/No
Q3: Did the paper mention about digital technologically enhanced user experience?	Yes/No/Partially
Q4: Will the paper conduct a narrative experience and therefore contribute to the research conducted?	Yes/No/Partially

After the first screening from the the scientific repositories, the pool of 173 has been semantically analysed in order to find among them the most relevant research to design a meaningful narrative experience in a cultural heritage context. From This pool a selection of papers has been picked up by a matching of an array of eleven indicators. The selection highlighted 32 papers that present at least 5 of the indicators in table 2.2 with a strong mark. The indicators have been marked by weak or strong, to fit a description that is available in the box, since it was pivotal to understand if the mentioned indicator in the text was effectively part of the design research process. table 2.2.

The chosen indicators are related to typical features present in different phases of the design methodologies. The features are both part of evaluation phases and supporting iterations of design, and part of the specific wording referring to the general methods such as co-design and participatory design. The indicators shown in table 2.2 plus the scenario trends underlined in section2.1 have been the tools that in a second and later stage allowed a further screening of 10 papers representative of specific CH narration in combined studies between HCI and Design practices.

The selection of 10 cases studies is briefly summed up in table 2.3. This final selection has been vital to define in the next chapter the design of the design iteration and the following evaluation of the Visitor Experience.

## 2.6 Stories from the cultural narrations and accessibility

In the early generative design process that followed the crafting of the main field studies, many ethical implications have emerged and then revised. Between

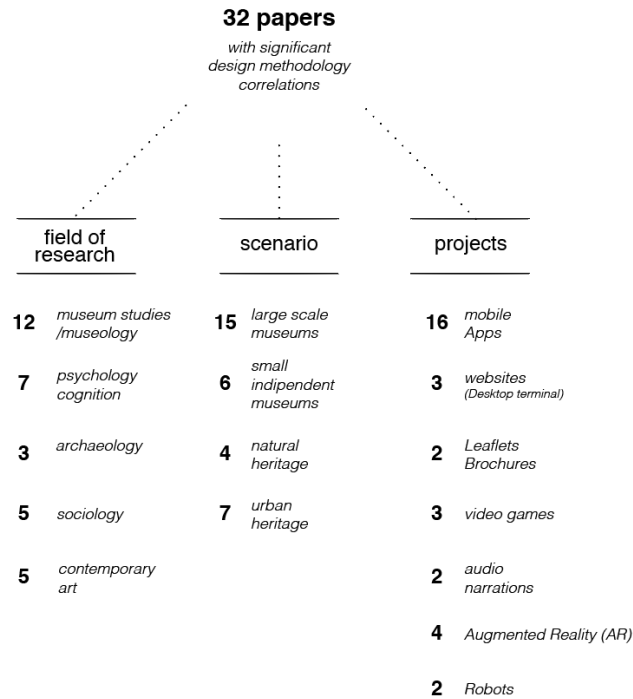


Figure 2.8: Overview of the data regarding the scenario, projects and field of research in HCI studies for cultural heritage showed in the papers with significant design methodology correlations. These correlations are indicated in the papers which present at least five indicators showed in Table 2.2.

the revised assumptions, has been necessary to examine and take into account the ones which were mostly fitting the context of use for the case studies that have been subsequently settled up in this research, based on the initial research questions.

A pivotal aspect of this research has been to **enhance the access to cultural sites** for visitors who already approach cultural sites, and for the visitors who are not yet engaged. Accessibility in this research has become a key aspect that we approached from the path of cultural diversity rather than other possible paths that could have been taken into account, such as physical or cognitive impairment. We made a choice of taking this into account in order to make the design process inclusive for the wider range of audience that would be engaged in the cultural storytelling, as stated in the forum for accessibility that took place in Turin in October 2018 [45].

A wide body of research has shown that an increased interest in investigating technological applications to enhance the visitor experience can be crucial to engage

Table 2.2: List of the indicators used to analyse the pool of papers for the semantic analysis.

INDICATOR	MARK	DESCRIPTION
<b>UXD- User Experience Design /UCD - User-Centred Design</b>	STRONG	The papers presenting these keywords are taken into account if the indicators are clearly referenced in the text as part of the design methods and approaches
<b>Design</b>	WEAK	This keyword is selected when in relation to the process and methodology adopted in crafting the user experience
<b>Co-Design</b>	STRONG	Considered when is explicitly part of the methodology
<b>Participatory Design</b>	STRONG	Considered when is explicitly part of the methodology
<b>Usability Testing</b>	STRONG	Considered when is part of the evaluation
<b>Interviews</b>	STRONG	Considered when is part of the evaluation process, or in the generative stage of the co-design session
<b>Focus group</b>	STRONG	Considered when is part of the evaluation process, or in the generative stage of the co-design session
<b>Workshop</b>	WEAK	Considered when is part of the generative stage of the co-design session but considered weak due to social bias
<b>Shadowing \ Observation</b>	STRONG	Considered when is part of the generative stage of the co-design session especially in the ethnographic process
<b>Survey / Questionnaire</b>	STRONG	Considered when is part of the evaluation process, or in the generative stage of the co-design session
<b>Prototyping</b>	WEAK	Considered when is part of the methodology process, but not taken into account when part of engineering processes

## Design features in HCI

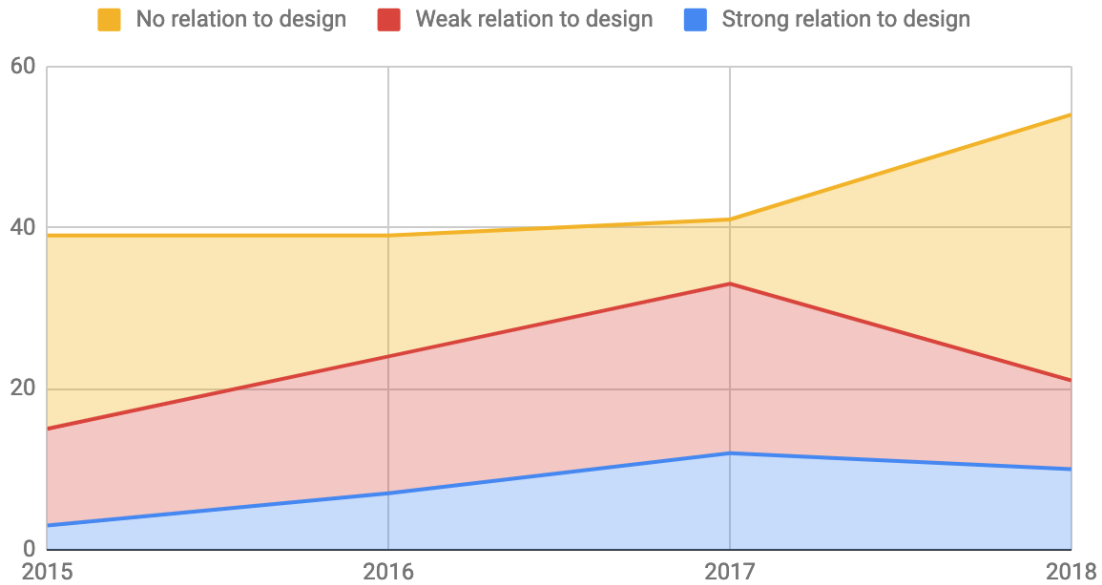


Figure 2.9: Design features mentioned in HCI publications. The graph shows the trend of Design presence in the HCI field over the last four years calculated according to a series of indicators that refer directly or not to design.

more with cultural heritage content. An enhanced visitor experience cannot just make the visitors understand the artefacts, it also needs to make people connect with the museum’s collections. The visitor experience can be affected by physical

Table 2.3: The table presents ten case studies that have been taken into account for crafting the explorations in Chapters 4 and 5. These cases have been selected because of the narrative nature of the design solution proposed to enhance the visitor experience.

University/ Institution	Cultural Heritage (CH) site Cultural Landmark (CL or Museum	Attribute	Location	Narrative experience solution
Sheffield Hallam University	/ Museo diffuso della Resistenza	personalisation Audio narrative situating artifacts	Italy	digital + analog
MIT/Seanseble Lab	Louvre Museum	visitor mapping user tracking	France	digital
Aalborg University	Oceanarium	Creating Stories User generated content digital devices	Denmark	digital
Aalborg University	Northern Jutland natural heritage	audio narrative mobile application	Denmark	digital + analog
Newcastle University Rock Art Mobile Project (RAMP)	Northumberland natural heritage	Online audio narrative mobile technologies situating artefacts	UK	digital+ analog
Van Abbenmuseum	Van Abbenmuseum	Experiential learning Co-creation	Netherlands	digital+ analog
Cornell University	Johnson Museum of Art	social, spatial, and semantic navigation	US	digital+ analog
Pennsylvania State University	Lost State City College heritage	Community awareness, digital cultural heritage, mobile application	US	digital+ analog
University of Glasgow PULSE	Edinburgh Built Heritage	AuditoryDisplay; Location-Based Services	UK	digital
University of Padua Phototrip	Villa Pisani natural and built heritage	Geolocalization, path planning, selected content	Italy	digital+analog

and cognitive issues from exhibition design and communication[71]. In this case is peculiar how analog and digital solution could effectively support an enhanced tourist experience. This positive collaboration is possible because of an attentive application of a design approach, that taken into account various human factors <sup>5</sup> In the next sub-chapters will be presented a brief description of the papers selection that helped in the crafting of the filed studies explorations in section ???. This selection of papers is reported briefly in table 2.3, and each case will be described in a dedicated sub-chapter.

### 2.6.1 Voices from the Netherlands - The Van Abbemuseum

The case of the Van Abbemuseum in Eindhoven is highlighting how an institution born in 1936 is fighting to be up to date and appeal to the visitors by being a public space where multi- stakeholder entanglement to define a new desired common future takes place[35]. This museum started few phases of renovation from the 2000is, but the one that intrigues the most is the one from 2009 to 2012, when the Van Abbemuseum has been exploring new ways to

<sup>5</sup>Part of this section is published in: Khan, Sara, et al. - Design challenges in promoting inclusion for cultural heritage contents through low cost technology - Proceedings of NordDesign 2018

increase the narration of the collections with story-telling devices that enhanced the narrative experience. The Van Abbemuseum started to explore new ways to interact with the public, after a series of workshops with the stakeholders and the visitors. The museum's staff decided to change attitude toward the visitors and to embrace a long term vision related to hospitality and experimentation rather than just conservation and education. This new vision allowed to create closer bonds both with the local community and the the virtual community that saw the museum's activities online [36]. In this approach, the Play Van Abbe I-IV series [149] [151] that were the precursors of what today are two of the main visitors trails: The Multi-sensory museum and the robotic museum visit. Both of the mentioned paths were explicitly designed to enhance the accessibility toward the collection, and they are the results of the interaction between the public and the museum staff. Other new visitors' trails were designed after this trial period, and the museum won the title over the internet as "one of the most radical and hospitable museums in Europe" [150]. The museum staff together with a research team from Philips started to create a tool, later called 'art tool' to test new digital devices and also more conventional ways to interact with the public. The results of these experimentations were stunning since they highlighted that people were welcoming digital tools alongside the conventional re-planning of old museum trails. The testing of the new museum trails included repeating collection presentation from 30 years earlier as a way to understand the passage of time and change in public perception and expectation [36]. In addition the results also indicated a majority of parallel stories in which artifacts could describe different situations depending on the contexts in which they were displayed, sometimes leaving one artwork in place while changing everything else around it, but just adding an audio narrative device. The case of the Van Abbemuseum is peculiar because, the art tool is essentially a design methodology that not just defines the best practices to follow, in this specific case new enriched exhibits with mixed analog and digital devices, but also it operates on a deeper societal level. This is possible because in the midst of so much discursive and immersive mediation between the visitors and the art, there plenty of space for connecting with the local communities and assembling innovation on small budgets [150].

## 2.6.2 Voices from Denmark - The North Jutland cultural Landmarks

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<sup>6</sup>Part of this section is published in: Khan, Sara, et al. - Design challenges in promoting inclusion for cultural heritage contents through low cost technology - Proceedings of NordDesign 2018

From 2010-2011 a mobile mixed reality treasure hunt, “Noorhjem”, game was designed around (then) state of the art technologies to scatter fragments of a larger narrative around in 31 different locations. SMS-messages and IVR-calls (Interactive Voice Response) were used to connect the narrative virtually and connect hidden physical clues at 31 locations, that translated to 31 different quests. Each of the 31 quests was location-based, interactive and was designed as an independent mobile mini-game. The game was designed to add a digital layer of information to the guests' visiting experience and bridge attractions scattered around Northern Jutland. Thus, Noorhjem could be played independently of the other experiences within 31 locations or as a combined experience. The key findings from this study, is that the majority of users experienced difficulties figuring out how to interact with the game, as they were unfamiliar with the (then new and unknown) interaction mode. From this we learned to carefully consider the on-boarding when designing applications and a “bring your own device” mindset.

### 2.6.3 Voices from England - archaeological sites in rural Britain

The Ramp Project is particularly interesting because aimed to define a Design methodology of UX narrative in CH, rather than prototyping a specific digital solution. At the beginning, researchers identified a tool in contemporary mobile applications, since they were looking for a low cost solution that would support an outdoor historical and archaeological sites narration, In addition from a screening from the literature they highlighted that using the personal mobile device (Bring your own device - BYOD) would speed up many digital illiteracy that would occur in encountering different devices from the everyday usage. The Narrative challenge for the Ramp project was to create a methodological approach that would designing and delivering mo-bile interpretation to three Neolithic and Early Bronze Age rock art areas in Northumberland, UK [47]. This project wanted to detach from the conventional archaeological mobile guide, and deliver instead an enhanced empathy with the territory by creating a "Design Space" and allowing the visitor to interact freely with the art. to trigger this experience, researchers used the already existing "*public's fascination matching with 'cryptic' meaning of the rock art sites and the technological, environmental and personal situation of the user to be explored and to inspire technological development*[47]".

This research focused on people's interaction in the everyday in order to support a narration of the natural context with an already existing amount of digitised media and a mixed mobile application. The interesting part of the projects was the iterative phases that brought to the realisation of the mobile app. These phases included a series of co-experience workshops, where the designers open up dialogue among participants, and between participants and the heritage. From this session

several issues and needs emerged such as the importance of allowing people to locate the artifacts in order to shape their own experience, and engage actively with the landscape. In these workshop was also investigated the level of familiarity participants have with their mobile devices, in particular during their visits to natural heritage.

The design approach explored in this research challenged, researchers, designers, heritage professionals and participants involved in the co-design workshops to take into account mobile interpretation not as mere medium for heritage information in situ [47] but also as an chance for enhancing engagement and creating a discussion with both one's companions, the natural landscape and its heritage.

#### **2.6.4 Voices from Denmark - The Oceanarium**

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The North Sea Oceanarium is a Danish aqua zoo with an aim to inform visitors through edutainment activities. As a part of their strategy, a mobile marker-less augmented reality application was developed to add a digital experience layer to the visiting experience. The application was a mixed reality game that created digital extensions of the physical scenography and provided pathfinding to the visitor. The visitor records live footage during their visit to the zoo. The footage is manipulated (a distortion effect) in real-time by the app, while special effects are layered on top of the recorded video, generating a scene where fish and objects interact with the filmed guests (figure 1). From this, the key take-away for this paper is that this application, although it was building on conventional use of a smartphone (taking pictures and recording videos), also proved difficult for to on-board new users. Several interventions were tested in order to on-board new users, such as instructional videos looping by the entrance and posters explaining how to acquire and use the app.

#### **2.6.5 Voices from Italy - Audio based narratives for the trenches of World War I**

In the natural setting of the Italian Alps, the research team from Sheffield-Hallam University implemented a co-design setup and evaluation for enhancing the visitor experience in cultural landmark: a World War I fortified camp and trenches. This co-design process brought life to a prototype that enabled an auditory narrative system automatically plays sounds and stories

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<sup>7</sup>Part of this section is published in: Khan, Sara, et al. - Design challenges in promoting inclusion for cultural heritage contents through low cost technology - Proceedings of NordDesign 2018



based on an array of triggers such as visitor proximity, location, and visitor preferences [93].

This co-design project is the result of the combined efforts of the museum's staff such as the curators and the guides, who selected and edited in the first stage the material for the audio narratives. The narrative has been designed to stimulate empathy in the visitors, but at the same time, to let them have the freedom to create their own interpretation of the events. For this reason, rather than using an impersonal transcription of the events pivoting the trenches, the first-person point of view and the personal accounts of the soldiers have been used for the narration.

The aim of the setup was to show that a co-design approach could efficiently merge a flourishing interaction between the visitors and the intangible and tangible heritage, creating a contextualization of archaeological remains [122] [77].

### **2.6.6 Voices from the US - The Lost State College**

A study conducted at Pennsylvania State University has been settled up in order to raise awareness in the local community toward the built heritage[55]. A social intent of the regional community was to connect the citizens with their own heritage, in this mindset, the researchers accepted the challenge and designed a technological solution. The technological nature of this solution is due to the introduction of ICT in CH, that has facilitated the digitization and administration of archived content of all kinds, including community-related content. Nowadays social platforms allow individuals to create and share their personal experiences with others in the form of user-generated content (UGC) [55]. With this aim, the Lost State College (LSC) App, has been created with the participation of different stakeholders a mobile platform that had the standard attributes of a tour application: giving access to official historical or current photos of the landmarks, text description, and a pre-recorded audio related to specific points of interest. The text descriptions included information about 14 historical downtown landmarks, such as houses, churches, diners, and shops. This platform was running on Android on specific tablets, and the study's participants were accessing the content while visiting the historical points. In addition to the standard tour information, this platform supported the creation of user-generated content (UGC) such as comments to the landmarks, photos and, likes. This study is a great example of how mobile technology could work for cultural storytelling as a tool to bond the community to historic landmarks in an interactive and tangible way to intangible heritage. This bonding promoted community awareness and a new way of learning to both support locality and official content generated from professionals in the CH field. Mobile devices are becoming a more ubiquitous, pervasive, and low-cost technology, and they could be used in a different array of interactive projects since the increasing familiarity from the users with the interfaces is a flourishing ground for new affordable solutions. In particular, the

users can experience a more active role in digital storytelling [77], since, according to one participant to this study “It gives you online social interaction, and I can see how technology can be applied to learn about community history” and “It is easier and more interactive, more fun. I would definitely use the app with my friends, using features like visits, comments, photos, etc.”[55]

### **2.6.7 Voices from the US - Archaeological collections in Boston - Johnson Museum of Art**

A significant research project developed at Johnson Museum of Art in Boston, in partnership with Cornell University, highlights new methodologies to improve the CH storytelling. This project, called MobiTag, aimed to integrate social, spatial, and semantic navigation inside a museum space and to improve users experience of the archaeological museum collections [23]. Mobitag works in a specific scenario, where it acts in support of a small collection of 51 objects distributed along three sets of glass cases on one floor of the museum. This interface helps people experience the objects while giving users more information, and therefore more control over their visit than a standard guided tour. The system supports users feedback to create "objects tags", I.E., someone tagged an ancient game board “beer pong”, and then the tag it’s shown on the interface where all the other visitors could access and like/vote the tags. On the app, all the users can vote the existing tags or contribute to generate new ones, increasing engagement and artifacts popularity. The study evaluation reported that users enjoyed the idea of having a detailed object information and the tags on the item page, and expressed the appreciation for having a tool that allows access to content at their own pace. Many participants stated that access more information was valuable, however the Log data from the app recorded that actually not everyone sourced it as often as it was mentioned, and only about twice on average per person. In addition, some participants reported that they enjoyed having access to the "cloud of tags" created after everyone’s visit experience, and that was a way to notice things in new ways or to miss less artifacts they could easily overlook if they were wandering freely in the museum without Mobitag. In similarity with many museum digital solutions, MobiTag encountered some criticism from the public, since it was a challenge to support information on a screen and not distracting the visitors from the artifacts in the displays. In this case, the balance between looking at the artwork and the device was quite hard and brought space for improvement. In conclusion, this study was able to merge both virtual and physical reality ambient, allowing visitors to actively interact with the urban environment and access the cultural content. Often, the interaction with mobile apps brings all the users attention to the screen [133], but in this case, visitors would be free to enjoy the city and not being fully absorbed by their devices [65].

### 2.6.8 Voices from Scotland - Glasgow and Edinburgh built and historic heritage

Researchers from the University of Glasgow developed a field study aimed to implement a mobile application for CH called PULSE. This application has been developed to allow tourists to reach a deeper understanding of the built environment and the historical information related to the Scottish cities of Edinburgh and Glasgow [99]. This digital solution is meant to enhance users' access to more specific content related to a geographic position (geolocalisation), and to create User Generated Content (UGC) that will possibly bind a more personalised experience of the surroundings. The interesting part of this study is that the information is conveyed with audio excerpts, which every user is able to listen to in precise locations. Result showed that users reported being enthusiast of this new way of sharing culture in a urban contest, since the standard tourists guides have a *"static nature, the information provided may not be congruent with the user's current experience of the environment"*. [99] In conclusion, PULSE showed insights on the currently limited knowledge on the presentation of geo-social media. Geolocalisation could significantly bring more affordance to the CH content, and increase interaction with UGC around the same geographic location. The audio narrative content and UGC audio also enriched the users engagement creating a vibrant and enjoying locative experience for the participants.

### 2.6.9 Voices from Italy - Villa Pisani natural and built heritage

Numerous interesting cultural landmarks are unknown to the wider public, in particular, countries who detain lots of attractions linked to a historical period struggle in attracting tourists [20]. Visitors tend to take into account the more iconic landmarks or pieces of art and missing much heritage "hidden treasures" along with their journey. However, travelers cannot be blamed for neglecting "hidden treasures" since most of the time there's no or very little access to local CH. The PhotoTrip project developed at the University of Padua aims to improve accessibility to natural heritage and built environment by applying a design approach to a cultural landmark, such as Villa Pisani. The project involved the creation of a tool that allows the visitor to access general information available on the web in a more precise way, by bypassing lots of unnecessary data and focus on the most coherent content related to the cultural site. The technical challenge for this tool is not just to provide the appropriate content, but also, linking it to a specific travel route.

In a nutshell, PhotoTrip allows travelers to access many geotagged and time-stamped pictures on the Web to experience local cultural charms. At the moment

this service is not provided by other Web alternatives. I.E., Google Maps gives access to photos related to a selected path but it does not filter images according to the user's needs in terms of thematic interests. This digital service acts as a tool to efficiently distinguish between relevant and non-relevant photos, and to guide visitors outside the iconic and most know touristic paths [20].

In addition, the evaluation methods adopted to analyse the system efficacy in this context (Villa Pisani) are related to UX usability testing. These methods will be later partially adopted in the case studies presented in CH 4.6.1.

### 2.6.10 Voices from France - the Louvre Museum

8

In order to smooth the visitor navigation inside the museum space diverse large scale European museums have been interested in the development of the new visitors' trails, or have used sensor technology to monitor and analyze their visitors' needs. The users' needs ignited an impulse to speculate new approaches in the social and museological fields. One example of these investigations is the study pursued by a famous museum, the Louvre. This museum, in partnership with the MIT Seanseable City lab, started to observe visitor clustering alongside the collection's masterpieces. This research was aiming to analyse visitors' hypercongestion and clustering through the use of a series of Bluetooth proximity sensors [167]. The Louvre visitor mapping provided information on the visitors' behaviour and circulation, however this research was not taken forward to find a solution to the navigation issues along the display. The analysis performed by the researchers at MIT shows visiting patterns that are curiously similar for both short-stay and long-stay visitors. Since the longer-stay visitors, they mostly spend more time around the iconic masterpieces instead of enjoying the rest of the less known museum's collection. In general, this research shows how understanding the visitor's behaviour by implementing the trails with very inexpensive technology, in order to create a more accurate mapping on visitors distribution in the museum space by creating a visual mapping. All this information, alongside a better understanding of the visitor's behavioral pattern, could significantly reduce any museum experience disruption.

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<sup>8</sup>part of this section is published in: Khan, Sara, et al. "Exploring new functionalities in cultural heritage spaces-designing different museum trails with low cost technologies." In: DS92: Proceedings of the DESIGN 2018 15th International Design Conference. 2018. p. 2251-2262.

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Figure 2.10: Participant exploring the new museum trails with the help of audio narratives and wayfinding map

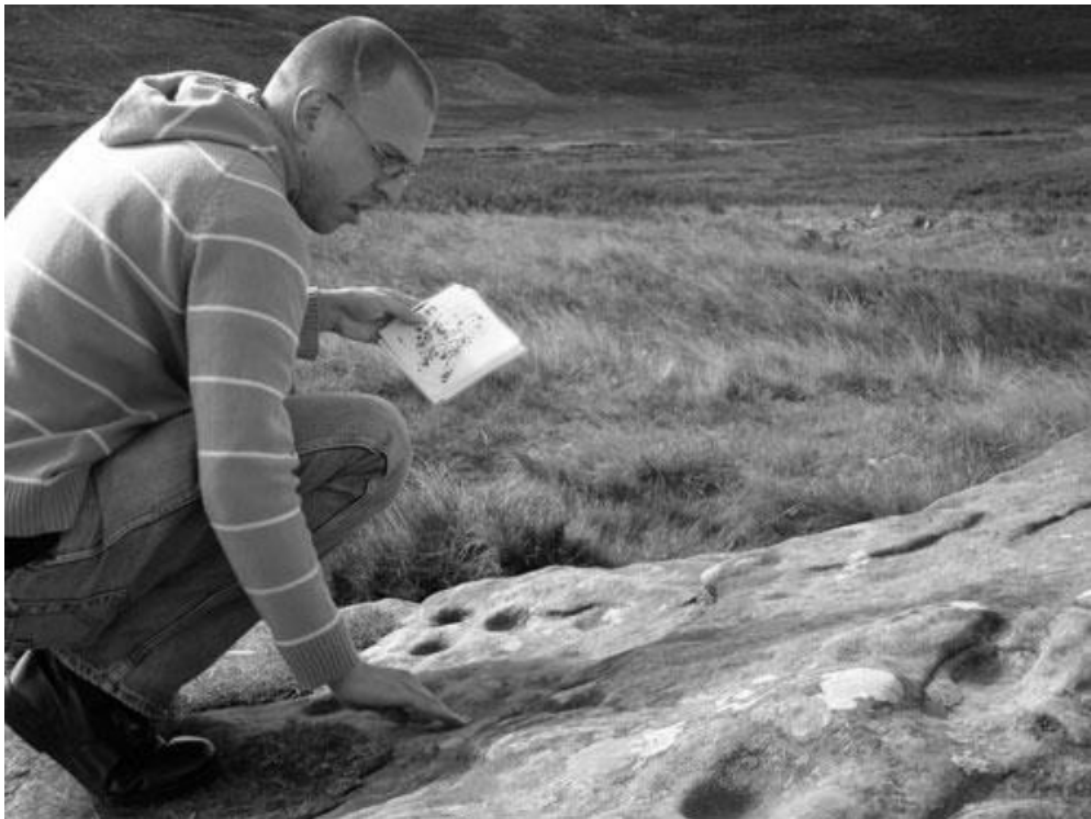


Figure 2.11: Participant exploring the carving through touch and visual material, Lordenshaw site visit [47]

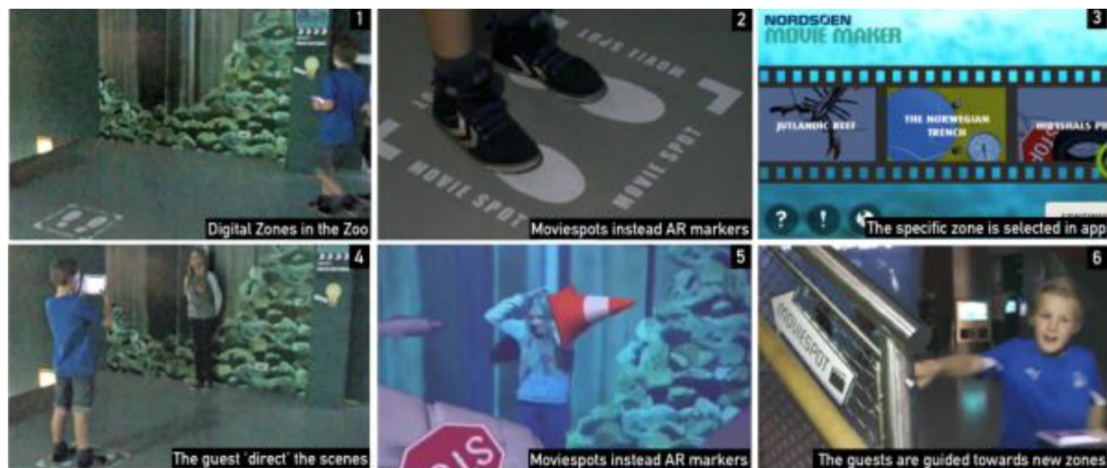


Figure 2.12: The user journey of the guest using the augmented reality app 'North Sea Movie Maker'(Vistisen et al., 2017)





Figure 2.13: The narrative experience in the "Museo della Resistenza", on the Dolomiti mountains

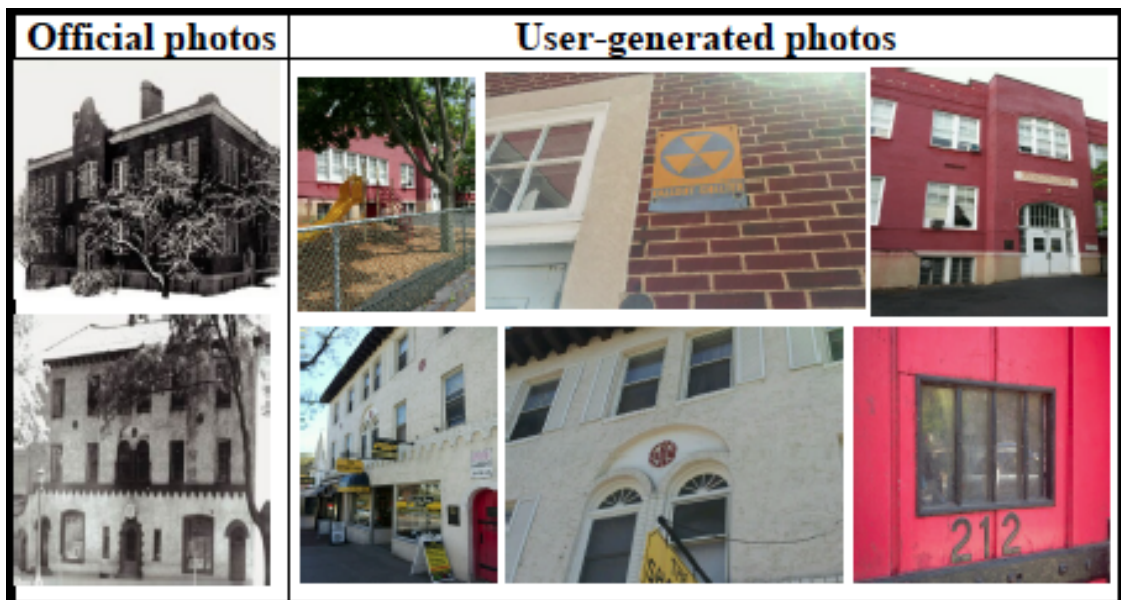


Figure 2.14: Examples of official photos and user-generated photos. Participants took various types of photos related to the landmarks.

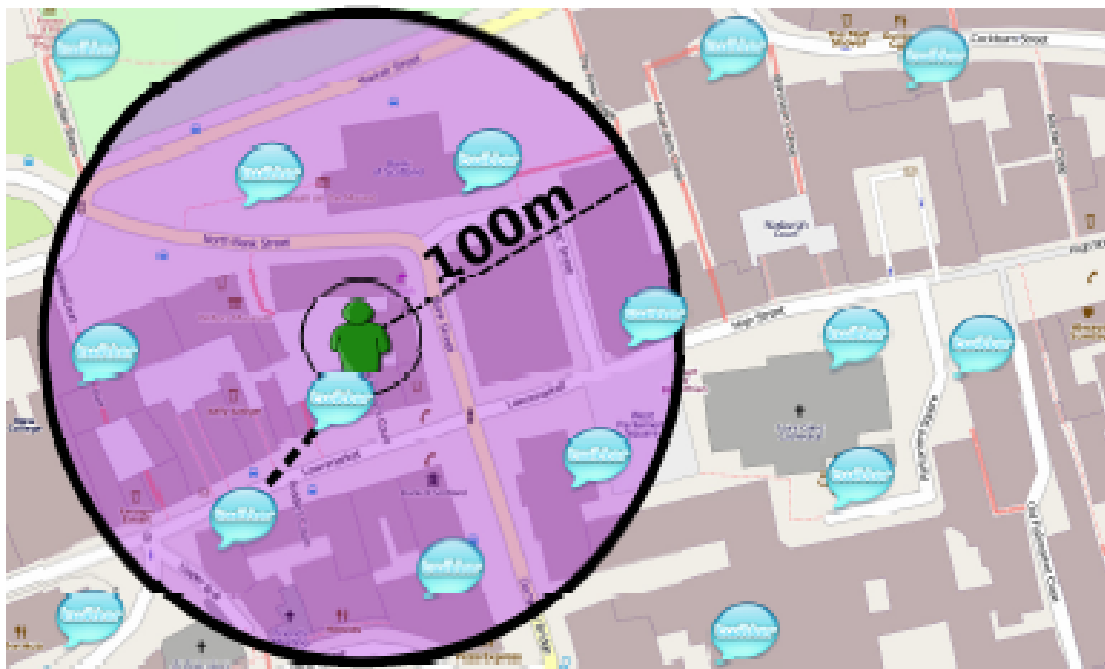


Figure 2.15: Voices from Scotland. Trend and Message Density are calculated from all of the messages in a 100m radius around the user's current location. Periodically, the closest message is selected, and presented spatially at a point 15m from the user along the same axis.



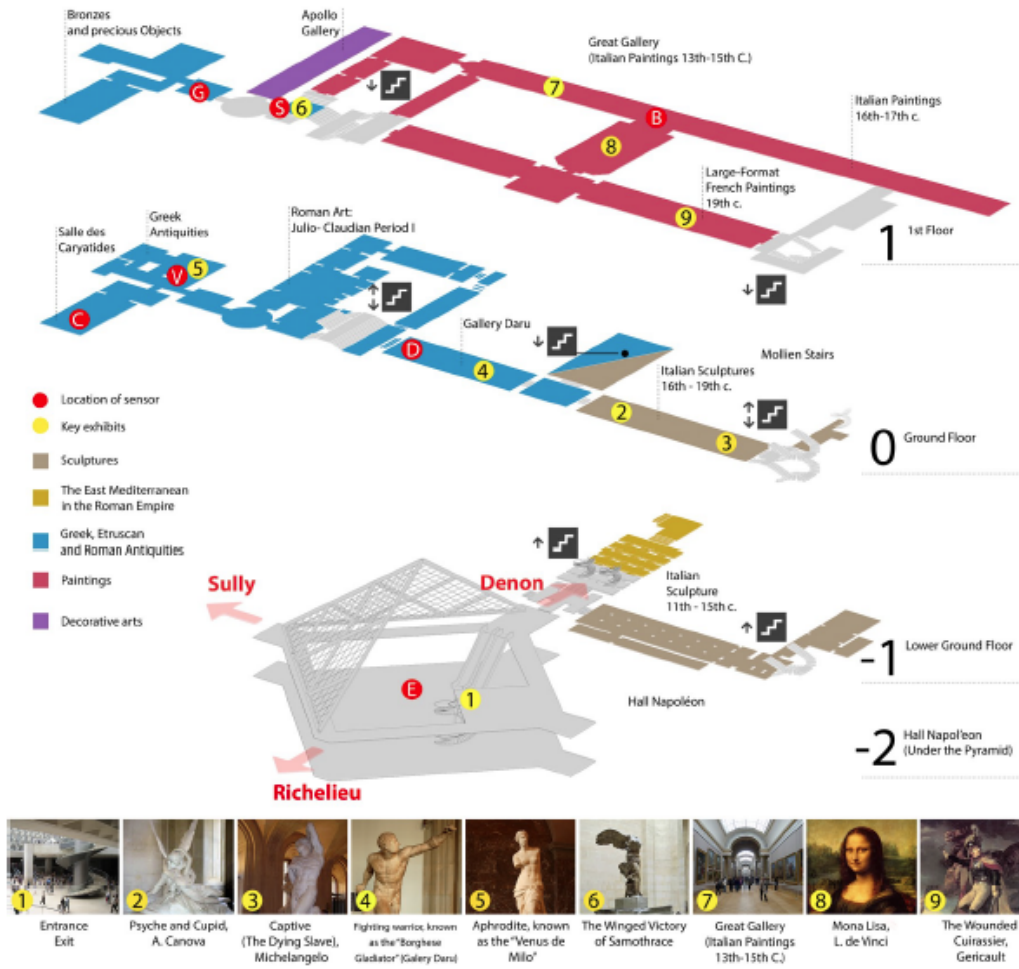


Figure 2.16: From the Louvre's study. [In color online.] Location of seven sensors E, D, V, C, B, S, and G, indicating their approximate sensing range.

## Methodologies and contributions

In this chapter, will be outlined the methods adopted to carry on this research, and the latter contribution that this study aimed to add. In order to pursue a more lean methodology, the Research through Design approach was taken into account, by adding methods from the UX design. This merging was aimed at obtaining a more lean and agile approach that could be helpful in an iterative process of product development.

### 3.1 A cognitive perspective: UX design to bridge cognitive psychology and HCI

The debate about which kind of contribution cognitive psychology could make to the field of human-computer interaction (HCI), and how helpful it could be has started at least 3 decades ago. In 1993 Draper [33] started to give a full commentary on this topic, but in 1996 Green et al. [53] finally brushed and defined a more viable path to follow, presenting a position in a debate that has been *'fuelled by unrealistic assertion whether cognitive psychology can supply everything that HCI needs, or that cognitive psychology is irrelevant to HCI'* [53]. Instead a more reasonable approach is to broaden the paths of research contributing to outline where cognitive psychology can achieve the most well suited improvement. An other issue that will benefit from UX approach to HCI is the implementations to the human factors (HF). Usually the Human factors integration in the design process is something perceived as a task analyses to be fed into these specifications related to ergonomics. But As stressed by Bannon [6], HF should be taken into consideration from the concept phase of each project since *'the role of HF or HCI in system design today should be more fluid and pragmatic'* [5]. Green pointed out that Human factors (HF), represented by psychology and ergonomics, even though they play a pivoting role in computer system design, are often overlooked [53] [22]. This is true if we consider that Bannon [5] suggest other perspectives will help in understanding the connection among people, technology, work requirements, and managing requirements, where

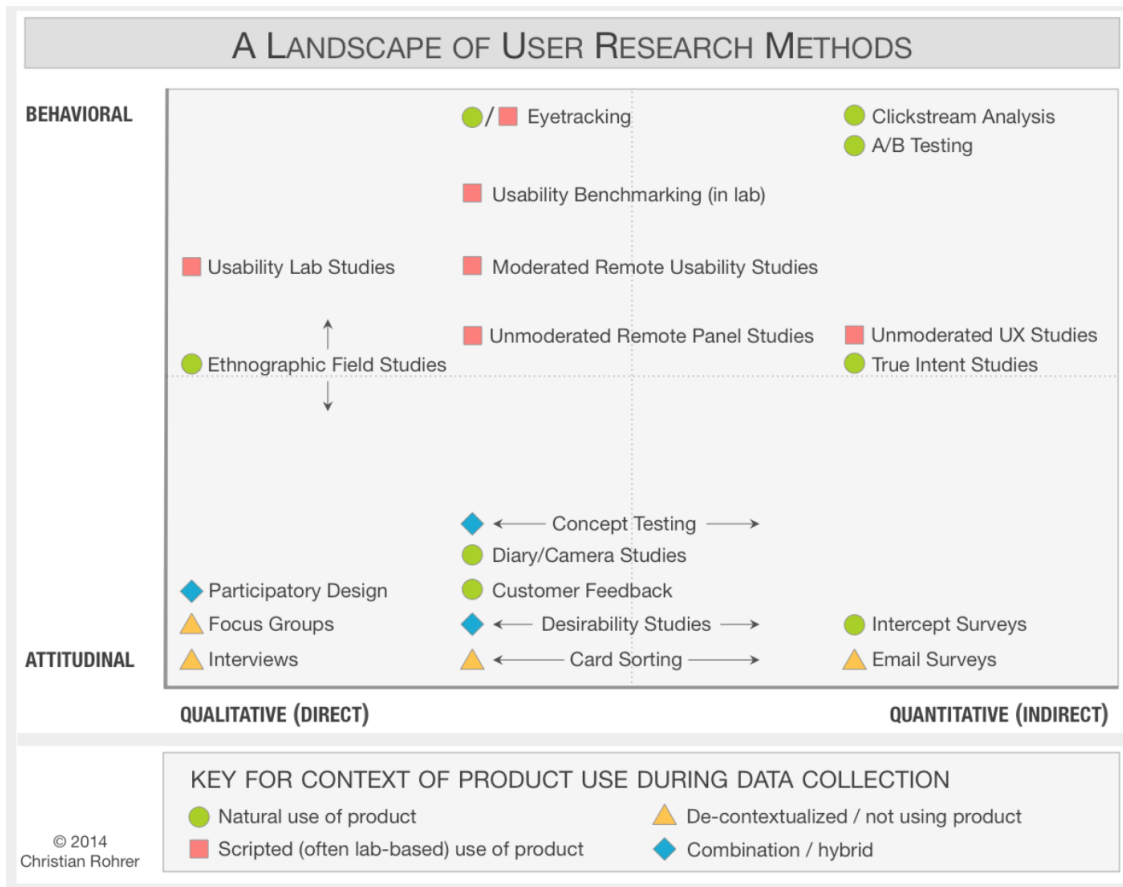


Figure 3.1: UX methodologies currently used in commercial case studies. According to Christian Rohrer (2014), Each dimension provides a way to distinguish among studies in terms of the questions they answer and the purposes they are most suited for.

Human Factors are real users, actors in specific situations. This is a big contribution in HCI research and cognitive Psychology. In addition, just focus the attention on the users not enough, since users are not simply passive subjects of study. People are, or can grow into active agents [6]. Carroll et al. [22] explain very clearly in their research how users have the desire to perform a task, and at the same time to understand the context. People are willing to go forward in understanding how to use an interface by themselves. If the interface is acting unclearly, users will try to make up an explanation for its behaviour, in the attempt to make sense of their surrounding world. Seeking for meaning in the interaction with digital artefacts is the key that triggers the User Experience Design, since this discipline is moved by the purpose of creating meaningful experiences for the users.

In conclusion it's possible to understand the transition from cognitive psychology, human factors to bridge gaps in HCI: an attentive UX planning could

take into account meaningful variables from the conceptual stage of the project till the end [11].

## 3.2 User Experience and Cultural Heritage

The user experience (UX) toward cultural heritage has been long analysed in museum studies disciplines. In fact, free-choice leisure and learning behavior have been key aspect of the museum experience, and at large of cultural experience[12]. Over the past 30 years, John Falk and his collaborator Lynn Dierking, have been investigating for decades the implications and disruptions as depicted in sections 2.3 and 2.3.5. Cultural landmarks are becoming hybrid spaces, where digital and technological solutions are presented alongside tangible artefacts. In this context, the case studies presented in the sections 4 and 5 of this thesis are playing a new role, providing methods to increase cultural accessibility and enhance the visitor experience. The aim of these explorations was not just to deliver stories hidden inside artefacts and objects and topics related to them, but also shed light for the conception of how to create new narrations. These narrations should craft an interactive visitor experience that lasts after the visit [32]. Dissemination is key, and in particular social sharing, user-generated and curated content have been taken into account to create a possibly meaningful experience.

As introduced briefly in section 2.2 and in section 2.2.1 taking advantages from a combined framework, it was possible to develop 2 case studies. These cases were supported by a co-design approach under the umbrella of the user experience research methodology.

### 3.2.1 Research through Design (RtD) and UX methods for a combined framework

In order to approach the complex nature of crafting a meaningful cultural user experience, a mixed design approach has been taken into account. In this section is going to be introduced the combined methodology adopted to craft the presented case studies. This methodology is a merge between the RtD approach widely discussed by Forlizzi and Zimmerman [170], and the agile User Experience methods firstly introduced by Norman [110], and then recently brushed by Rohrer [125], who also defined more in details a diverse landscape of user research methods, as reported in Fig. 3.1.

The UX methods have been essential in order to shape a more personalised visitor experience, as introduced in Section 2.5.1, since a balance of different issues have requested the creation of design tools based on the users needs. Nowadays, contemporary UX methods are answering a wide array of questions [125]. According to Rohrer [148], it's essential to navigate through behavioural and attitudinal issues

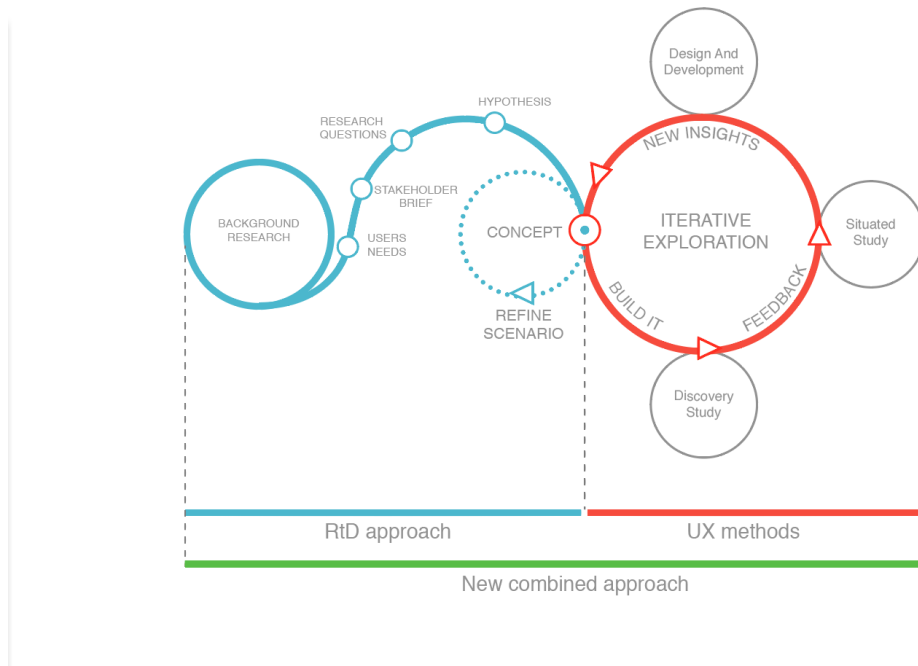


Figure 3.2: The combined approach defined for develop the two main projects carried out during the research activity. This approach is a combined framework between the Research through Design and the UX methodology.

that could appear throughout the whole iterative process of the design exploration and development. In Fig. 3.1 are shown twenty methods that bounce between qualitative and quantitative analysis, and could be implemented with a co-design approach underlying the Research through Design (RtD) framework. A combined framework is essential because it allows to take the best from a more academic approach such as the RtD and the agility of a product development one such as the UX method. However is not feasible to apply the full set of methods on a given project [148], even though almost all experimentations would benefit from multiple research methods that could shed light on significant insights. To facilitate when to use each UX research method, the RtD was fundamental in highlighting the appropriate timing of application, since each method is spread across three dimension, as depicted in Fig. 3.1. The 3-dimensional framework according to Rohrer is spread across:

- Attitudinal vs. Behavioral
- Qualitative vs. Quantitative
- Context of Use

## 3.3 Explorations to implement the visitor experience - project's methodology

### Explorations to implement a narrative path

In order to create feasible frameworks of action for an implemented cultural experience, has been vital to define a specific methodology for the research path. This methodology, as mentioned before in Section 3.2.1 is a combination of a Research through Design approach (RtD) and UX methods, sourced on based on the context of application for two case studies that have been crafted for the sake of this research. It is important to say that during the design experimentations, different phases have been developed, with the aim of depict proper tools of research and support the investigation in a more agile way. The tools have been created by taking into account all the design issues reported in the literature Section ?? of this thesis and according to mainly two pivotal features of the RtD approach and, such as investigating design contexts through designing solutions/experiences and creating meaningful outcomes for the end users.

According to Forlizzi [44] it is important to create tools by framing a context of application where subsequently they'll be applied. The process of framing is arranged in the proposed methodology in three main phases/studies that are smaller parts of the iterative process. In the method proposed by Forlizzi and Giaccardi [44] the three main phases of research could be depicted in these main actions:

- shifting from problem solving to problem seeking
- transiting from sketching ideas to draft human relationships patterns
- transitioning from prototyping solutions to understand the impact of technological solutions on a given context.

The great new entry of the RtD approach is to shed light on the significance of defining the problem and understanding relations, but also, to include the idea of a context/system as a whole behaving entity, and how it is affected by the introduction of new technologies. The researchers of the RtD approach were referring to technology at large, but in this thesis we still preserve the point of view of HCI matchin it with User experience design. User experience, usually abbreviated as UX, is for Normann the definition of the level of quality if experience a person incurs when interacting with a specific design [110]. In a nutshell User experience (UX) design is the process of creating products that provide meaningful and relevant experiences to users.

The entire UX design process also envisions the context of use as a whole behaving system, but it approaches the product development by testing its usability, feasibility, branding, and ultimately approaching its functionalities.

In this research, the RtD method with the 3 phases has been included in a typical UX iterative process. The iterative process has been developed not just to deliver a concept, but to understand and test user accessibility [45]. Accessibility as mentioned in section 1.2 is a great piece of the scenario puzzle in this investigation, and was the ultimate goal to increase it with the help of HCI solutions, not the opposite.

In this, designers can contribute both through the actual development of novel artefacts and through the established human-centered practices by investigating the experience of the people and highlighting how the factors of a system affect them (Norman and Stappers 2015). [142]

The field of expertise which this investigation is located is between Human perception, behavioural psychology, Human-centred design and Computer engineering are difficult to balance but that's why a new approach as been crafted. The new approach as depicted in Fig. 3.2 is split in 2 main sections that include 5 subsections. The blue colored phase is related to the background research and concept development, that itself it is refreshed as soon as new insights help to shape a more precise scenario. The red phase is essentially the iterative exploration process finalised in this case in understanding a meaningful visitor experience. The iterative exploration is a balance between essentially 3 phases:

- Discovery stage
- Situated study
- Design and Development

The **Discovery phase** is meant to be the place for understanding the design issues and better shaping the research questions. These issues will subsequently introduced in the Design and Development and adapted for situated studies, which all contribute to the iterative nature of this research. The outcomes of the research are particularly focused on the ubiquitous nature of the solution, which includes aspects of human acceptance, interaction with users and behaviours.

The **Situated study** phase is meant to be between the discovery stage and the DD. The situating activities have been grouped into two projects that have been conceived with the aim to understand the socio-cultural context with a focus on the cultural environment. Implement different scenarios can bring out significant variations in the meanings assumed by Mobile Applications. Therefore, this methodology was applied in two different contexts: the Egyptian Museum in Turin and Pluggy in London, described respectively in chapter 5 and chapter 6. The two projects approached the same design issues with somewhat different processes, even though both consistent with the overall methodology structure and purposes.

The actions of the **Design and Development (D&D)** have been focusing on the users understanding while creating windows of opportunity for situated case studies, that will be in this stage evaluated and give birth to new insights or confirm old assumptions.

**for a better accessibility This involves the design of the entire process of acquiring and integrating the product, including aspects of branding, design, usability, and function.**

### 3.3.1 Technical tools and connections between the explorations

According to Ryan et al.[127], "*Cultural and natural heritage **mobile applications** have proved to be an attractive vehicle for HCI researchers.*" In fact, a large number of projects, as partially depicted in the Ch. 2 of this thesis, have developed data collection tools, museum or city visitor guides as a way of revealing a vast array of concepts. These concepts are meant to bridge cultural and natural heritage from the research environment to its consumers [127]. In the last two decades, Mobile Apps have become more and more pervasive in the everyday, and therefore could guarantee a better accessibility to a wider range of users, as seen in Chapter 2 in the ten case studies analysed in detail. In addition, the smartphone technology allows to significantly reduce the cost for technical tools, both necessary for implementing the museum experience in a more seamless way, and improving an adoption rate from cultural institutions [154].

### 3.3.2 Situated explorations and improvements

In this thesis two main situated experiences are reported, in lieu of bringing significant contributions for further applications. The explorations have been designed to optimise the method reported in Fig. 3.2.1 where the RtD and the UX are combined together. The first exploration in the Egyptian Museum is to be intended as a environment very well defined, such as the selected rooms and showcases from the permanent collection, with more variables related to navigability and accessibility. In the first explorations the variables taken into account to analyse the data were fewer than the ones who have been taken into account in the second exploration in London.

The second exploration has been designed to take advantage from the lesson learnt from the first one, in terms of accessibility and technological tools, and with an increased open air scenario, such as the built environment heritage of Albertopolis in London.



### **3.3.3 Methods contributions - Agile iterations with situated explorations**

The investigation of an emerging field often demands innovation in methodologies and approaches. In this investigation mobile technologies have been targeted as already embedded part of the current environment since nowadays people carrying mobile devices and interacting with its technology has become the norm. Following recent research activities conducted in this field [124, 100, 17] in situ, of situated studies have been conducted in this research with the aim of discover new aspects of human life that need to be studied in new ways [78]. Situated activities such as the ones that will be presented in Chapter 4 and 5 of this thesis are very much indeed meaningful to this extent, since laboratory conducted studies are less prone to shed light on over all context of use that demand an increased accessibility, as it it the case of the cultural experience. Yet, there is plenty of room for method innovation around in the wild studies for mobile and ubiquitous systems, and a more agile methodology could certainly help in identifying new scenario of application and new users needs.

## Experiences - 1st design exploration

This Design Exploration has been led in partnership with Telecom Italia (TIM) and the Egyptian Museum in Turin (Museo Egizio) with the aim to enhance the visitor experience in the renovated collection's showcasing. The Museum has undergone a huge renovation that achieved the final stage on the spring of 2015. This renovation implied a huge amount of funding that was leaving little budget for further improvement of the collection's improvement. In this situation, with a need for improvement in the fruition of the permanent collection, a design approach as described in Section 3.3 was tailor-made for this exploration. Specifically **this approach has been applied in order to understand how to better coordinate a project that involves the development of an intangible asset: a new museum experience through new visitor's pathways.** The project itself started on between the end of 2015 and beginning 2016, and the operational team was composed by staff from the curatorial and media dept. at the museum, designers from the dept. of Arch. and Design (DAD) and one Engineers, two Developers and one Psychologist from TIM. This investigation lead to create a sensor system composed by Bluetooth sensors and a mobile interface. This system as been deployed and tested prior to understand visitors behaviour and enhance the museum trails.

### 4.1 1st Design Exploration - The Egyptian Museum

<sup>1</sup>

Different museums and cultural heritage institutions are seeking new ways to improve access to their artefacts and collections. The huge impact of the digital

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<sup>1</sup>part of this section is published in: Khan, Sara, et al. "Exploring new functionalities in cultural heritage spaces-designing different museum trails with low cost technologies." In: DS92: Proceedings of the DESIGN 2018 15th International Design Conference. 2018. p. 2251-2262.

revolution shed some light on diverse approaches to minimize the visitor’s museum experience disruptions and enhance the accessibility to the exhibits. This chapter describes the processes that led to the design of a sensor system by improving the access to the cultural resources. In order to enhance the museum experience it has been decided to adopt a non invasive and low cost technology solution. This study has been conducted with the aim of providing new suggestions to analyze visitors’ behaviour and their needs and design new visiting trails for the museum. In particular this set up is specifically designed for large scale museums which host archaeological collections.

### 4.1.1 Introduction

Central to the entire discipline of visitor studies is the concept of museum experience. This experience “begins before the visit to the museum, includes experiences within the museum (interactions with staff and members of one’s own group, as well as with other visitors, exhibitions, interpretive materials, and programs), and continues long after the person leaves the museum”<sup>5</sup>[38]. Furthermore, the museum experience is something that can be designed and enhanced [38] with the help of technology [3] in order to let the visitor learn from the artefacts.

According to King and Lord [75]: *“museum learning is a voluntary, informal activity. The voluntary nature of the experience has much to do with deciding what to see within the museum space. Navigation is agency; people decide with their feet. The initial requirement for successful museum learning, whether online or onsite, is clear navigation.”*

Museums often have to respond to visitors’ basic needs of locating themselves into an unknown space. These needs can span from finding the toilet or the cafe to specifically looking for a showcase or the newest exhibition [38], and for this reason, a tool to navigate inside the museum’s space should fit the users needs with a high level of personalisation [3]. As introduced in Sec. 2.5.1 of this thesis, a good level of personalisation can enhance the museum experience by tackling the physical and cognitive issues that could disrupt the visit, such as hypercongestion and museum fatigue. In addition, the museum visitors can belong to different target and age range, for this reason it can be helpful to adapt different features and contents for every user profile [126].

## 4.2 Processes and project roadmap

The methodology used in this project has been previously introduced in Ch. 3.2 of this thesis. This approach has been useful in following a precise path to perform

the whole exploration, and define each part without drifting away in its complexity. In order to don't miss any precious data for the later evaluation of the prototype, the UX testing methods have been integrated in the RtD approach with a sequence that follows a circular motion and define the whole iterative exploration.

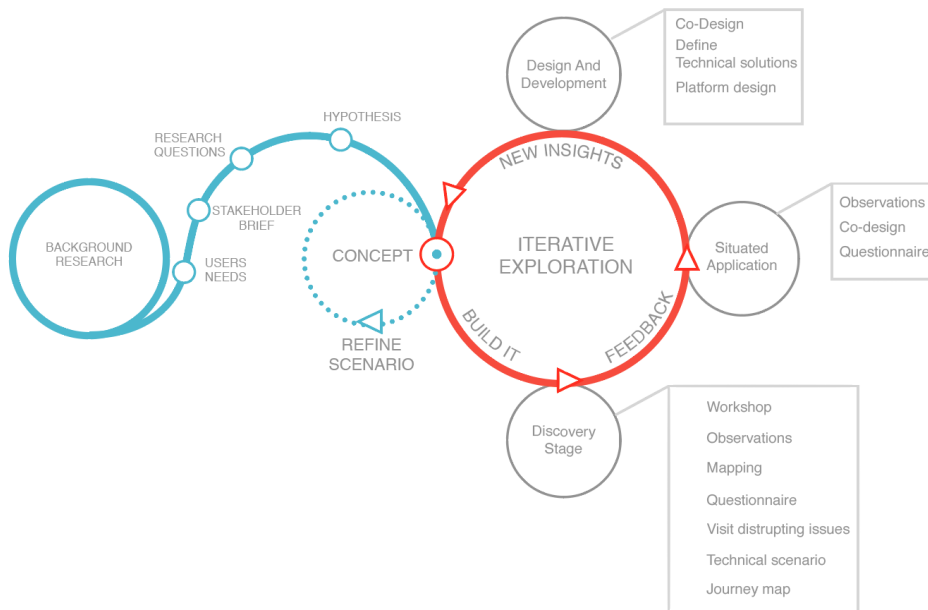


Figure 4.1: The process of the 1st design exploration. This scheme illustrates the road map of the research action performed.

Each phase of the iterative exploration has been integrated with actionable design activities focused on understanding the users needs and providing insights for developing the App prototype.

In the first part of the project was almost entirely devolved to the discovery stage, that helped in understanding the scenario, the context of use and which kind of technology would have been of proper use (if it was the case). The discovery stage was essential to connect on a common ground different stakeholders such as the Egyptian Museum, TIM and the academic research party from the Politecnico.

From each institution, professionals helped in each step such as engineers, developers and a psychologist from TIM, curators and part of the Digital media office at the museum, and researchers with one leading investigator from an academic background. Putting together different parties has been necessary in order perform the to co-design that brought the concept of the project.

In the second half of the project after the scenario analysis viable technical solutions have been considered. Two phases have been developed such as the

situated application and the Design and Development stage to refine the prototype and the methodology further contributions. The situated application has been particularly helpful in testing and evaluating the solution in order to generate results for shareable knowledge.

### 4.3 Concept of the sensor system App

As introduced in literature in Ch. 2.1, many challenges are arising in the cultural heritage scenario toward a better accessibility. In this study was tackled the complex problem of enhancing the museum visit without a creating a visible solution, and give museum's professionals a tool to effectively measure the efficacy and the engagement of the visitors.

Knowledge of a situated engagement infrastructure made up of mobile, stationary, ubiquitous, and remote systems frames the design experiments suggesting a wide range of different application for visitors to engage with planning issues within an array of various contexts and situations [78].

The concept behind the 1st Design exploration envisioned an App capable of delivering different museum trails for specific time constraints and themes. Since one of the most recurring issues between the visitors was the huge amount of time, almost four hours on average, needed to see the whole permanent Egyptian collection and the paucity of following a specific theme among the the artifacts. In addition, the museum itself was eager to adopt a tool to understand users behavior around the showcases, in order to evaluate the exhibits and get insights on visitors needs.

### 4.4 Understanding the collection: the Egyptian Museum case study

The real demand of understanding visitors behaviour inside the museum is not new but not very much explored in the literature [39]. The need to understand visitors behaviour has been started with Gilman in 1916 [50], went through post-war years of WWII with Wittlin [161], and came into the spotlight recently again with Falk [38].

The concept behind this interest, is however underestimated, since This exploration was carried on by adopting the a combined RtD and UX approach as previously seen in Section 3.3 of this thesis. The approach combines efforts directed to test a design tool (the sensor system) and subsequently evaluate it, in favour of the engagement of potential user in a cultural context.

The project's aim is to grant an improved fruition of the museum's display, enhancing visitor museum experience. In order to investigate the combination of



Figure 4.2: The concept behind the 1st Design exploration envisioned an App capable of delivering different museum trails for specific time constraints and themes.

digital and non-technological solutions to improve the visitors' experience, it was fundamental to combine different expertise from the engineering area, the design background and the humanities.

This exploration differs in few aspects from the next one illustrated in Chapt. 5 of this thesis. The diverging points are obviously related to a different composition of the stakeholders network, since in this case the presence of a corporate component such as TIM made a great impact in the decision making

process. At the same time, having the Museum as one of the stakeholder involved in the co-design process brought voice to very specific needs that a cultural institution have, and in particular the concept itself is something aimed at helping both the museum's staff and then the end users, such as the visitors.

The iterative project phase following the background analysis and the literature review spurred after a stakeholder briefing, that took place in a facilitated workshop, further described in sections 4.7.3 and in the results. The briefing and the stakeholder workshop were both part of the discovery stage, which also gathered more insights from a manual mapping, shadowing and questionnaire from the end users (the museum visitors). In the iterative process, the discovery stage aimed at refining the insights of the initial briefing and use to the obtained feedback to craft a situated study that first took place in the lab, and later followed a short test in the museum itself. Later on the Design and Development stage further refined the concept of the sensor system. The situating actions were precious in understanding a low cost technical point of view, that is part of a still ongoing collaboration with the Museum.

In addition, the research question have been taken into account to define the ante and post situation for each design exploration.

In the case of the Egyptian museum, was important to "raise awareness toward cultural heritage?" since the museum has always been seeking for an enhanced accessibility and it was in the results of the literature review, In addition, from the findings from the literature review, was important to improve visitor's engagement with cultural heritage. I addition, low cost technology was a way to introduce tools for enhanced accessibility in an environment with very few tech solutions.

## 4.5 Analysing the Museum Experience with the help of UX

The museum experience is mostly learning oriented and the leisure factor plays an important role in terms of learning [161]. To allow visitors to enjoy leisure time inside the museum it's crucial to understand how people interact with the collections and the showcases. The 'stress as a human factor' can influence the perception of the museums' artefacts and could be detrimental to the learning experience that these cultural institutions usually offer. The stress variable can be composed of two main issues: hyper-congestion and museum fatigue. These two issues related to visitor studies have received considerable critical attention in recent times [28] [39]. The methods from the design and in this case, UX perspective are aiming of developing a sense of empathy towards the users the solution is going to be designed for. For this reason a heavy ethnography research has taken place, following the steps of observing, mapping and understanding the possible context of use of the sensor system App.



### 4.5.1 Low cost technological solutions and applications

In order to smooth the visitor navigation inside the museum space diverse large scale European museums have been interested in the development of the new visitors' trails, or have used sensor technology to monitor and analyze their visitors' needs. The users' needs ignited an impulse to speculate new approaches in the social and museological fields. One example of these investigations is the study pursued by a famous museum, the Louvre anticipated in Section 2.6.10 of this thesis. This museum, in partnership with the MIT Seanseable City lab, started to observe visitor clustering alongside the collection's masterpieces. This research was aiming to analyse visitors' hypercongestion and clustering through the use of a series of Bluetooth proximity sensors [167].

The Louvre visitor mapping provided information on the visitors' behaviour and circulation, however this research was not taken forward to find a solution to the navigation issues along the display. Instead, the science museum of Trento MUSE, located in the north east of Italy, uses a simple Bluetooth technology to suggest to the people new visiting trails by providing simple insights on the displayed objects. The Trento's museum uses a simple pop-up interface installed on a tablet given to each visitor. This tablet works not only provides audio content, but also includes the possibility to enjoy extra multimedia contents triggered by the proximity of the Bluetooth sensors. At the MUSE, the Bluetooth technology is used for a more efficient interaction with users, while at the Louvre the same devices were used to monitor and analyse visitors' behaviour. But according to Ardissono [3], the main challenge for an enhanced museum experience was to reach an increasing level of personalised support during the museum visit, since *“cultural heritage sites have a huge amount of information to present, which must be filtered and person enable the individual user to easily access it”* [3].

Moreover, according to Ardissono [3] and Falk [38], since the visitor's behaviour does not remain consistent during the visit, it may require an ongoing adaptation to each individual and situation. This is mostly due to the composition of the museum visit experience that consists of a combination of physical, socio-cultural and identity related aspects [38]. *“Cultural heritage has been a powerful field of application for personalization for many years and recent museum studies' research acknowledged the need for personalized, individual support”* [3]. John Falk's [38] describes the museum experience as a combination of cognitive factors. Therefore, it's possible to say that a good level of personalisation can enhance the quality of the museum visit, since visitors *“may benefit from individualized support that takes into account contextual and personal attributes with a support to an ongoing adaptation.”* [3]. This exploration combines the user behavioural analysis with the visits path planning. In the case studies that have been taken into account, the analytical aspects are combined with the paths suggestions, in order to give the visitors an enhanced museum experience.



## 4.6 Iterative exploration

The iterative factor in the adopted methodology is what it makes it agile. The iteration process is what defines the product goals altogether with the concept, with the aim of integrating factors such as accessibility from the very beginning, and not just at the end of the prototyping. Iterative design is a design methodology based on a cyclic process of prototyping, testing, analyzing, and refining a product or process [66]. After the insights from the iteration is possible then make changes, refinements and create more empathy with the users.

With each iteration cycle, once a user need has been identified through user research, new ideas are generated to meet that need, and the prototype becomes more clear. Iterative design exists to support research in how do people behave, discerning the differences between what often do people tell they'll behave, and what do they actually behave. User research is then paired in this case with ethnographic research, such as the shadowing/observations in the museum that defined the personas and the end users.

The ethnographic analysis in this research was vital since many ideas popped up during the co-design process, but knowing the users better helped in making decisions in the App functionalities.

### 4.6.1 Designing an enhanced museum experience

The general aim of this project was to enhance the museum experience, since some hints were put on the table by the museum party, addressing some well known issues. These issues were described as disruptive factors of the visit, such as the long time needed to fully engage with the whole collection, and the fact that many visitors without a museum guide were asking for help in the wayfinding inside the rooms.

But before starting to the define the App functionalities, was essential to make sure these assumptions toward the visit disruptions were realistic renderings of the real picture. For this reason, the iteration started by looking into visitors behaviour looking for the real issues occurring during their museum experience.

## 4.7 Discovery stage

The discovery stage as anticipated before in Sec. [iterative\_stage1] is meant to be the place where assumptions toward visitors needs could be validates, rejected, or even new ones are sorted.

But what was aimed to be obtained from the empathy study in this exploration? Since *"Engaging with people directly reveals a tremendous amount about the way they think and the values they hold."* [66], this stage was crucial to engage with

people directly, for example during the manual mapping and the observation time in the museum's space. Also, the workshop and the constant briefs within the stakeholders helped greatly in defining the project's objectives.

Gaining insights allows to depict a realistic scenario a meaningful experience with the design artifacts, and in this project was essential at first to understand the nature of the Archaeological museum context such as it is the Egyptian museum. Since not all the museums have the same audience, and they tend to interact differently depending on the kind of objects showcased. In addition, the manual mapping described in Sec. 4.7.7 really showed up which issues do the visitors encounter during their visit.

### 4.7.1 Archaeological museums, material culture, and digital media

Archaeological museums could result boring to many visitors since they often don't show particularly bonding narrative experience, and as a result, people could feel a sense of boredom due to the lack of connections with their everyday life. However, this is a great missed chance, since often archaeological institutions host collections that showcase objects of the everyday life of people who simply lived a long time ago, hosting effectively a great material culture repository. Sadly enough, in many cases, the objects are exhibited in a way that doesn't create attractiveness to visitors, who often find themselves standing still "*on the conveyor belt of history*" [135, 121].

However, cultural institutions necessitate strengthening, their attractiveness of their visitors to survive, and making cultural heritage more engaging, especially for 'digital natives' is a must.

**Undoubtedly, the next great challenge for CH landmarks is to make good use of the material culture narrative they could create (especially in archaeological sites) with the more and more ubiquitous presence of digital media.** [121] This challenge is not easy since it also includes a fierce competition with entertaining and leisure based industry that attracts people with sensational exhibits, often lacking in educational qualities. In addition, digital solutions for enhancing cultural content could be very expensive, difficult to maintain and technically hard to make. However, this gap is where design research could be really helpful in creating a window for improvement.

As the literature shows in Section 2.9 in the last decade a huge effort in HCI for CH investigated how digital storytelling could enhance the visitor experience, and according to Pujol "*personalization and adaptivity, and mixed reality, coupled with mobility-enabling systems, promise to make not only cultural heritage sites more attractive but also to provide new means to convey cultural knowledge, interpretation, and analysis more effectively to audiences.*" In this sense, digital solutions could significantly create opportunities to employ new cultural

interactive experiences, without "wasting" the existing digital libraries and content that has been already developed in the CH field [121].

### 4.7.2 Wayfinding, navigation and path planning

According to Jansen [67] space related issues concerning the museum's physical environment can be detrimental to the museum experience and the learning activity. The digital museum experience can be helpful as a tool to aggregate people with social activities and engage visitor's interaction. As explained by Jansen, physical element in the museum environment can: *"contribute to the atomization of visiting groups. This atomization disrupts visitors' abilities to engage in joint activity and to sustain interaction over time and space. In the absence of such coordinated activity and interaction, perspectival reciprocity can no longer be taken for granted – issues related to the lack of connectivity – physical space issues"*. [67]

With the aim of deepening the understanding of spatial navigability in museums, a significant analysis and discussion on route planning Apps was presented by Pugacs et al. [120]. In their detailed examination of a framework to evaluate the interactive route planning Apps in tourism, they showed that use a planning App can provide a chance to let the tourist engage with their personal will and time constraints. Drawing on an extensive range of sources, and with the creation of journey maps, the authors set out the different ways in which: *"an alternative approach allows us to achieve two things: it provides an interactive environment where the user can explore many possible itineraries with little effort. It provides an explanation of the properties of the tour, since the tour is automatically generated based on preferences indicated by the User"* [120].

Using journey maps and heat maps to track the visitor's behaviour can be beneficial to understand the user's needs [94]. According to Martella et al. [94] the heat maps can show the amount of time spent in areas close to artworks and give valuable insights into visitors' behaviour to researches and museum professionals.

But why it is so important to understand how people navigate in the museum space? The need to understand visitors' movement is not new to the research area of museum studies. In 1988, Nathalie Heinich published a study showing that a ubiquitous technology that could fully support the exhibit's narrative power can be worthwhile to understand how people navigate and sense the museum space. Data from the studies of Heinich [59] suggested that the multitude of museum's spaces should work cohesively with the aim to guide visitors in an educational leisure experience, giving the users freedom to access the culture at their pace. The visitor's pace is mostly driven by the given personal time they can dedicate to the visit and their personal interests. Following this purpose, the project is motivated by the pursuit of a ubiquitous exhibit technology, that can detect visitors' needs but also break down the barriers of incomprehension toward the artefacts.

### 4.7.3 Workshop and kick off meeting

To conduct this exploratory study on ubiquitous technologies and to capture the complexity of the phenomenon and set up the preliminary guidelines, a workshop with the project’s stakeholders was organised and coordinated by the design department.

The workshop has been conducted with a total number of fourteen participants. The team was composed by seven museum professionals such as two people from the Digital media Dept. and five curators, three engineers from TIM and four researchers from Politecnico di Torino. In addition to the fourteen participants, two Design researchers acted respectively as the facilitator and notes taker.

The discussion verged from the actual perceived situation within the museum party, from the possible solutions proposed from the technological point of view of the engineers. Was clear from the beginning that a balance between these two parties was one design challenge itself, since the museum pushed for a better monitoring of the visitors behaviour while from the engineering side there were more technical driven solution put on the plate. In the end with the help of a creation of a common ground that facilitated the view of a user centred perspective, the collaborative nature of the workshop offered clear insights into the main issues that the visitors had with the museum experience. The museum management proposed the following directions to the issues:

- To expand the museum’s community, including more young adults
- To design different visitor’s trails
- To boost the dissemination of the museum’s events and activities aimed to increase the number of visitors

### 4.7.4 Preliminary questionnaire and data collection

The present research explores how to enhance the visitors’ museum experience. The efforts made so far in this direction showed in the presented case study, that in order to achieve an enhanced museum experience it’s possible to adopt low cost technology. In the analysed case study, the proximity sensor system could achieve a good level of personalisation of the user experience and minimize the effects of hypercongestion and museum fatigue to improve the user’s experience. According to Ardissono [3] the visitor can be able to “exploit cultural heritage material before, during and after the visit, having different goals and requirements in each phase of their experience”. So a level of preferred variables can be included to enrich the users’ museum visit. On the other hand, technology can be ubiquitous and sometimes overwhelming in terms of the amount of given information, and still the content should be assisted or filtered by the curators [3]. As we mentioned in the

introduction, a questionnaire was distributed to the 35 museum visitors to prove the need of a better museum experience. This survey has been conducted in order to:

- Understand the key issues concerning visitors' collection's fruition
- Estimate and approximate the the percentage of the visitor with orientation problem inside the museums space
- Estimate the average visit duration
- Determine the composition of the visiting groups

We can observe from the preliminary questionnaire analysis, the main issues expressed by the visitors are related to a slight tortuous path to follow in order to enjoy the permanent collection. Also the data are showing a huge average time of visit (mostly over 4 hours). Furthermore, these data have been beneficial to validate the preliminary functionalities' implementation of the sensor system, since it was possible to identify the areas and the rooms where the sensors could be located to to possibly achieve an enhanced museum experience.

Also with the help of the survey was possible to have an average expected time for each visit, around four hours (see Fig. 4.3), and to understand if people could really have struggled to follow a specific narrative path. These findings helped to set up the functionalities of the proximity sensor system. From these findings, we can assume that in order to improve the museum experience it's vital to more effectively investigate the relationship between the museum and the public, and between the artefacts and the visitors.

Creating an inclusive tool for understanding the artefact that can be driven by the creation of new visitors' paths could highlight the paucity of previous visitors' experience and enrich their visit.

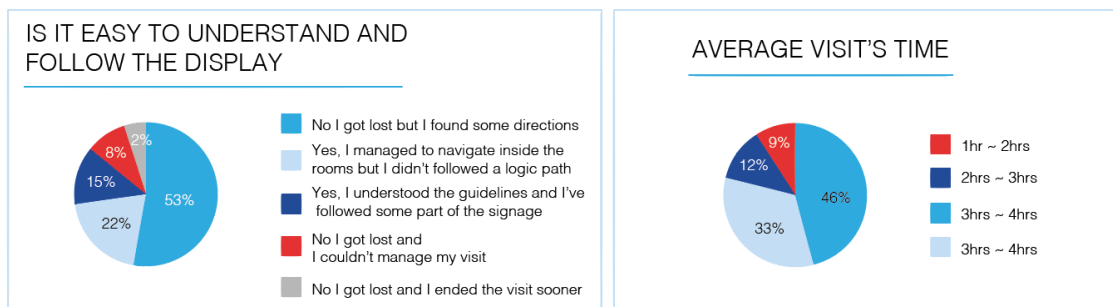


Figure 4.3: The visitors' survey data related to the average time devoted for a visit in the museum and the level of understanding related to the permanent collection

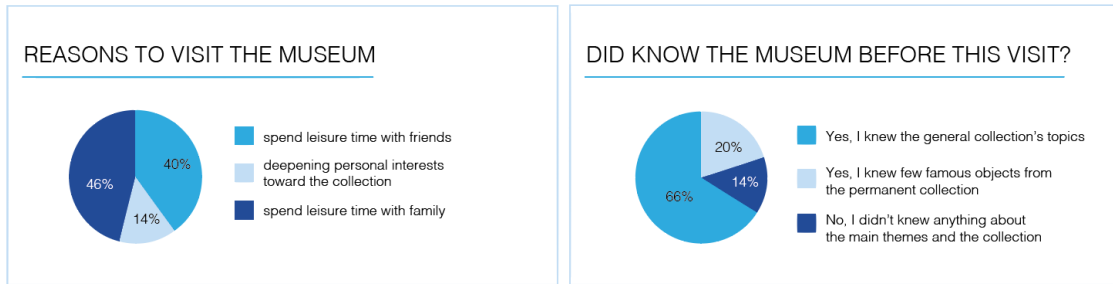


Figure 4.4: Visitors' survey shows some basic data about the reasons that mostly drive people to visit the museum and how knowledgeable they are about the collection

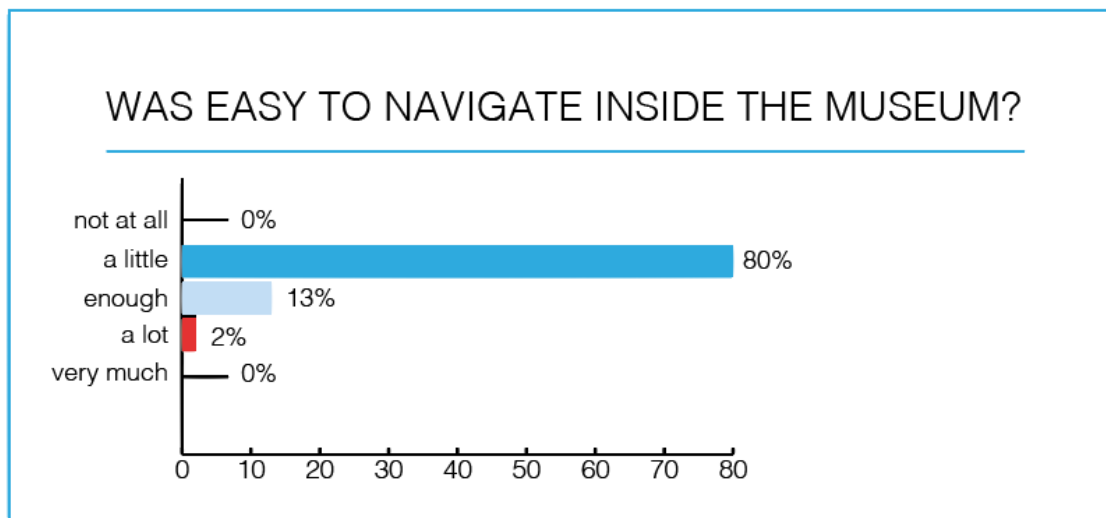


Figure 4.5: For most of the interviewed visitors, navigating inside the museum was not effortless

### Preliminary questionnaire results

The questionnaire showed a significant amount of time was spent from the visitors to navigate and enjoy the whole permanent collection, as shows Fig. 4.3. The average navigation time is around 3 to 4 hours and alongside a clear some evident lack of understanding directions along the display shows significant disruption to the museum visit's experience. These disruptions are even more important if as shown in Fig. 4.4 since the reasons that lead people to visit the museum were almost all related to social interaction in their leisure time, and given this as a fact is very hard to catch visitors attentions who are not solely moved from an educational purpose. Especially because the large scale of the display and the signage was somehow creating issues in the overall museum navigation, as shown in Fig. 4.5.

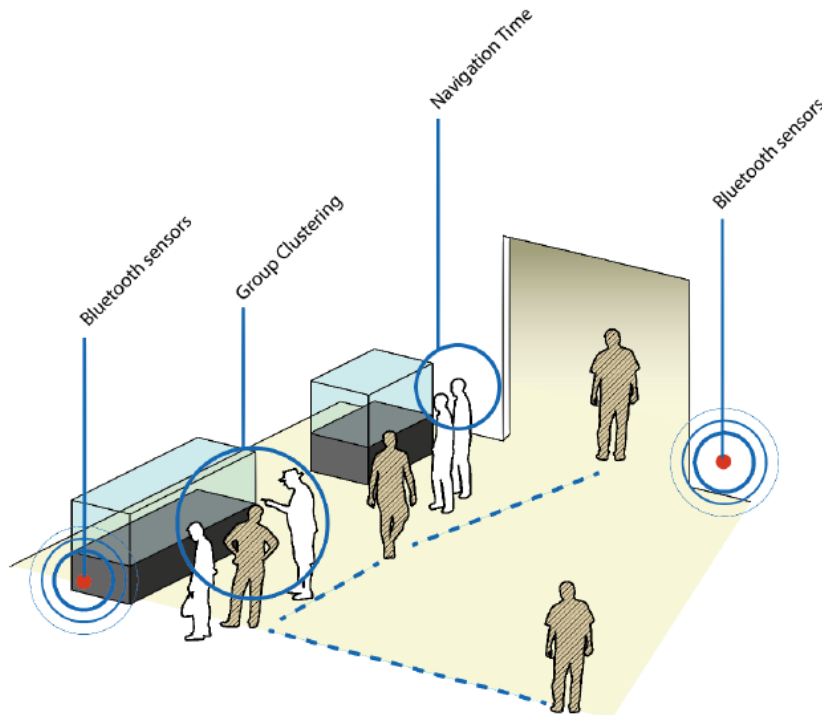


Figure 4.6: The figure shows the non-invasive position of the proximity sensors. The sensor system is aimed to be embedded in the museum trails, avoiding any visit's disruption.

#### 4.7.5 Technical scenario

The technology selected for this design experimentation was developed after the discovery stage, since this project is user centred and not technological centred. The concept of the sensor system was triggered by the need for an ubiquitous technology, mostly invisible to the user that would help them interact better with the objects in collection. The museum party was very firm on not adopting flashy and distracting digital solutions, since the main attention should have been devoted to the artifacts in the showcases.

#### 4.7.6 Low cost technological solutions and applications

In order to smooth the visitor navigation inside the museum space diverse large scale European museums have been interested in the development of the new visitors' trails, or have used sensor technology to monitor and analyze their visitors' needs. The users' needs ignited an impulse to speculate new approaches in the social and museological fields. One example of these investigations is the



study pursued by a famous museum, the Louvre anticipated in Section 2.6.10 of this thesis. This museum, in partnership with the MIT Seaneable City lab, started to observe visitor clustering alongside the collection’s masterpieces. This research was aiming to analyse visitors’ hypercongestion and clustering through the use of a series of Bluetooth proximity sensors [167].

The Louvre visitor mapping provided information on the visitors’ behaviour and circulation, however this research was not taken forward to find a solution to the navigation issues along the display. Instead, the science museum of Trento MUSE, located in the north east of Italy, uses a simple Bluetooth technology to suggest to the people new visiting trails by providing simple insights on the displayed objects. The Trento’s museum uses a simple pop-up interface installed on a tablet given to each visitor. This tablet works not only provides audio content, but also includes the possibility to enjoy extra multimedia contents triggered by the proximity of the Bluetooth sensors. At the MUSE, the Bluetooth technology is used for a more efficient interaction with users, while at the Louvre the same devices were used to monitor and analyse visitors’ behaviour. But according to Ardissono [3], the main challenge for an enhanced museum experience was to reach an increasing level of personalised support during the museum visit, since *“cultural heritage sites have a huge amount of information to present, which must be filtered and person enable the individual user to easily access it”* [3].

Moreover, according to Ardissono [3] and Falk [38], since the visitor’s behaviour does not remain consistent during the visit, it may require an ongoing adaptation to each individual and situation. This is mostly due to the composition of the museum visit experience that consists of a combination of physical, socio-cultural and identity related aspects [38]. *“Cultural heritage has been a powerful field of application for personalization for many years and recent museum studies’ research acknowledged the need for personalized, individual support”* [3]. John Falk’s [38] describes the museum experience as a combination of cognitive factors. Therefore, it’s possible to say that a good level of personalisation can enhance the quality of the museum visit, since visitors *“may benefit from individualized support that takes into account contextual and personal attributes with a support to an ongoing adaptation.”* [3]. This exploration combines the user behavioural analysis with the visits path planning. In the case studies that have been taken into account, the analytical aspects are combined with the paths suggestions, in order to give the visitors an enhanced museum experience.

#### **4.7.7 Analysis and data collection: timing, tracking and mapping visitors’ behaviour**

In this section we are going to describe the procedure for the data collection, that supported the design of the enhanced museum experience concept.



### 4.7.8 Second workshop findings: key points and tools to improve the visit

After the questionnaire distribution among the museum visitors, a new workshop with the museum professionals and two engineers from TIM as carried on. This workshop session has been useful to get deeper in the co-design process and define together a viable solution after the preliminary questionnaire findings. The guidelines presented at the end of Section 4.7.3, such as the need “to expand the museum’s community, including more young adults”, the necessity “to design different visitors trails” and the pursuit “to boost the dissemination of the museum’s events and activities aimed to increase the number of visitors” lead the workshop discussion. As this case very clearly demonstrates, it is crucial to find better strategies to make the museum experience more engaging, through simplifying the visitors’ navigation inside the collection or minimizing the hypercongestion [90].

At this point was clear that the museum has welcomed more than two million visitors in almost two years after its total renovation. The main issues expressed by the museum management were the visitors’ hypercongestion along the permanent collection and showcase, and the disruptive average visiting time that usually extends over four hours. The average visitor should take approximately four hours to navigate the whole display of the museum, that is developed alongside four floors of a late XVII century building. The current extension of the main and only museum path is distributed over four storeys and it spans about ten thousand square meters. These preliminary details help to understand the stress and fatigue that most of the visitors are expressing to the museum institution, it’s really hard to navigate through the entire collection without exhibiting even minor signs of tiredness[50]. Furthermore, the majority of the objects treasured inside the Egyptian museum’s collection are related to material culture and everyday life because the museum is an archaeological institution.

Being an archaeological museum means that most of the objects displayed in the showcases could be very similar to each other, for example the average visitor can become bored if the full display contains more than forty samples of the same headrest, or a hundred tiny fragments of a wide stone decoration [147]. To optimize the learning activity inside the museum, and to tackle the museum fatigue and hyper-congestion, it has been fundamental to settle up a way to convey, through a form of storytelling, the meaning and the information of the artefacts along the display [130]. In addition, the museum has been completely renovated in its image and display, and because of that minor changes could be operated on the showcases and the general setup.

Taking into account all the issues described above, and the state of the art concerning the existing case analysed in the related works session, it would be legitimate to think about a low cost, and minor environmental impact solution to

suggest different paths of visit. In this peculiar research project, a sensor system was designed to address all these issues, and the Bluetooth technology seemed the most convenient in terms of costs and device implementations. The overall project's design should consider environmental and spatial variables in order to grasp a wider scenario of the museum's space activity. The visitors' clustering and their time of permanence in proximity of the showcases can provide better picture of how to design an interaction design tool to:

- Communicate the contents of the museum's collection in a more efficient way while testing the efficacy of the permanent display;
- Deeply understand and enhance the visitor's museum experience by tackling the weaknesses of the museum trails and reinforce the key points of the display;
- Empower the museum's services, such as the bookshop and the cafeteria, and to take account of general service management standards and accessibility;
- Understand the needs of design specific pathways for families, young visitors and old visitors, while analysing people's personal interests inside the museum space;
- Enhance the potential attraction of some artefacts along the display, underlining the most and least seen zones by the visitors along the trails;
- Decrease the museum fatigue and hypercongestion phenomena to improve the visitor experience while estimating the visitors' permanence time and aggregation areas along the trails.

#### **4.7.9 Timing, tracking and, observations**

Traditionally, visitor's behaviour mapping has been assessing timing and tracking constraints to evaluate the exhibits [91] [13]. This approach can be fruitful to highlight the visitors' expected and intended behaviour while they are approaching the collections. The behaviour's mapping can be performed manually from the data collector or could rely on sensor technology, but nevertheless it could provide valuable information to control the process about the target collections' display, that can be used for designing future exhibitions [165]. In addition, to make the data collection even more understandable, the spatial analysis was supported by a sensible mapping technique widely used in the urban planning field [134]. These two approaches were essential in order to depict the gathered data in a direct way throughout a graphical visual render of the visitors' flux. The advantages of combining the behavioural mapping and the spatial analysis is that it is possible to create floor plan heat maps and have an

immediate feedback on the visitors' navigation. This technique has also been adopted by Bollo and Dal Pozzolo [14] to track the user's behaviour, but their potential bias in the data analysis was minimized in adopting a combined framework based on specific variables; we will discuss more in the following Section 4.7.10

#### 4.7.10 Defining visitors' scenario manual mapping and observations

Mapping data was gathered from multiple sessions of shadowing at various time points during three months of observations. These observations were useful in the follow up phase to help designing the functionalities of the sensor system for checking the visitors' time of permanence around the artefacts and obtain information on their clustering alongside the display. The mapping has been intended as an ethological approach and has been followed from a visitors' questionnaire since in observational studies, there is a potential for bias from the real user's behaviour that can be clarified with interviews or questionnaires [91].

The ethological approach has been intended in this study as a basis to attempt to understand human behaviour [52] as an adaptive response to different stimuli from a museum's space. However, these methods can highlight some restraints, but they have wide applicability in museum studies [130] since they can support a sharp primary examination; particularly in our case study, because we have applied a manual analysis of the visitors' behaviour. But which kind of variables were recorded during the case study described in this stage of the exploration?

The visitors behaviour mapping was based on the conceptual framework proposed by Yalowitz and Bronnenkant [165]. Since there's a huge number of variables that can be analyzed in a timing and tracking study, the ones recorded for this investigation are based on Serrell's work [136] who described a methodology to gather data tailored on the purpose of the particular case study that can include a standardized approach to rely on. In addition, the basic guidelines used to evaluate and filter the results obtained from the mapping were given during a preliminary co-design workshop that involved the staff from the institutions who actively participated in the whole project. The following bullet list reports the Serrell's situational variables that may affect visitors' behaviour:

- Levels of crowding
- Month or season
- Day of the week
- Time of day

- Any special events or programs going on at the museum
- Any special events or programs occurring in the exhibition
- Presence of staff, carts, or other related experiences

As a result, from the Serrell’s framework elaboration [136], the following variables in the museum’s observations were taken into account:

- How much time each person could spend alongside the display
- Identify the most populated zones on each floor (visitors clustering along the display)
- Run the observations on definite days on the calendar (festive days, weekdays, special city holidays, and specific scheduled events)
- Provide basic targets of classification of the visitors (age, interests, gender)
- Investigate the reasons that motivate the average museum visit



Figure 4.7: Visitors navigation heat map of the first floor realised after the observation sessions; The heat map depicts the clustering of people’s aggregation in the museum’s space; A colour indicators shift from the coldest, deep blue, to the warmest bright red; The areas depicted in cold colours show the lower populated portions of the floor plan, while on the opposite, the warmer colour has been used to show up the more congested areas in the map.

The data emerged from the observations according to the previous guidelines helped to understand the behavioural pattern of the visitors inside the museum [50]. The first tree variables, which define time and space constraints, have been used to develop the heat maps of the visitors preferred paths. The last two guidelines

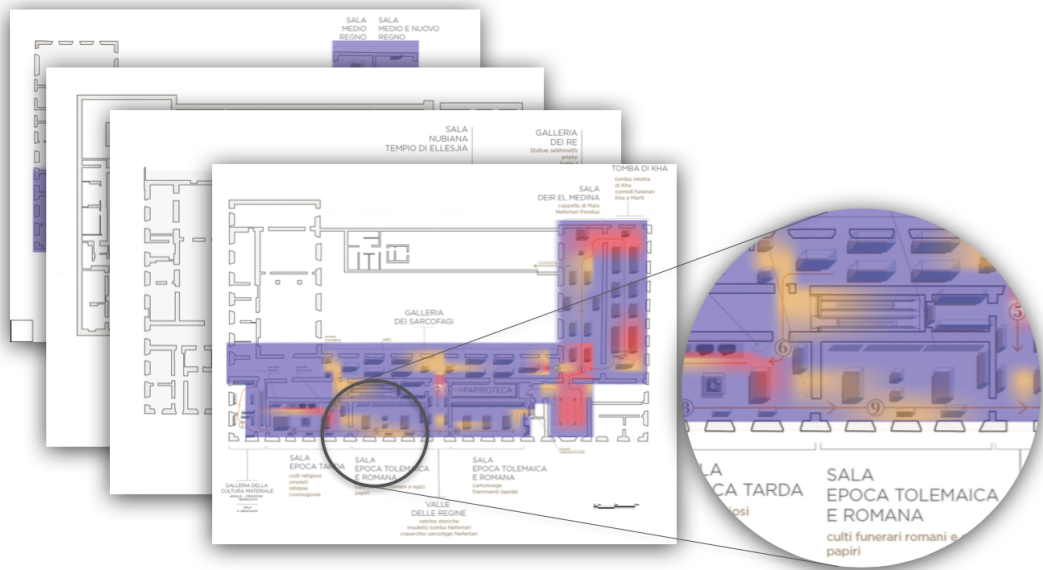


Figure 4.8: The figure shows the heat maps of the museum floor plans indicating the areas less visited from the visitors (cold colored) in contrast with the more visited ones (warm colored).

have been applied to the visitors' survey research to deepen and complete a museum experience comprehensive. To achieve this preliminary overview, it was compulsory to make an on-site examination operated by an observer. The observer has been collecting the whole data in more than 35 sessions for a period of about three months, between April and June 2016.

#### 4.7.11 Preliminary results, requirements and user needs

Observation and mapping are a primary source of data in qualitative research and also the critical tool to understand the causes of the disruption in the museum visit. The observation sessions that spanned over three months, gave the insights to create the heat maps that really define the visitors movements inside the rooms and highlight which paths are more prone to be walked down, such as the ones closer to the cafeteria and the one showing the most celebrated pieces of the collections, such as the tomb of Kha. In addition, people seemed to genuinely enjoy anything that was put in the showcases following a narrative path, like in the first segment of the museum trail where the "history of the collection" and the way it has been retrieved from the Egyptian soil is displayed. However, as the user journey map shows in Fig. 4.10, anytime the captions of the showcases are too many or too difficult to connect with one another in one narration, the visitor attentions dramatically drops. In addition, depending on the visitors affluence it could be more challenging

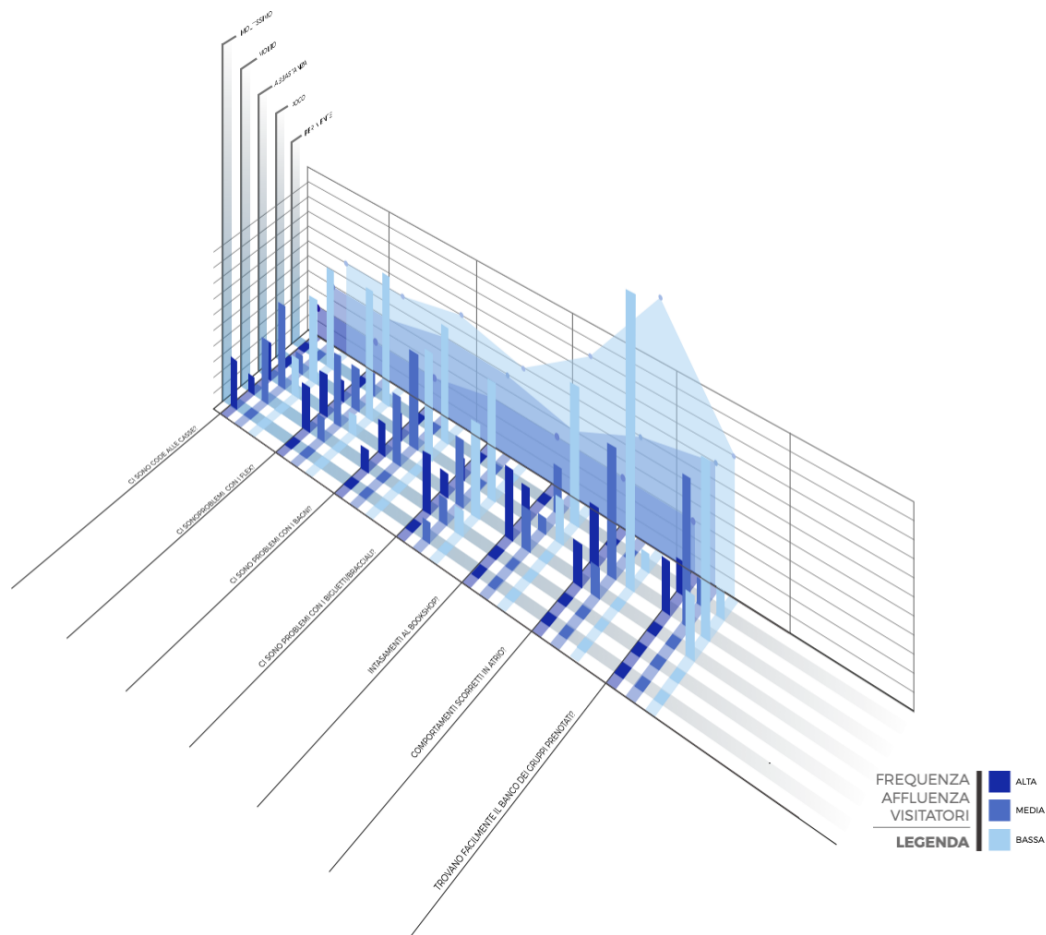


Figure 4.9: The figure shows the results of the mapping and observations carried inside the museum. Specifically this diagram shows issues in the museum's spaces accessibility as the visitor flow changes.

to engage with the artifacts, due to the Hypercongestion phenomena.

## 4.8 Design and Development

This phase of the project was aimed to improve the sensor system concept and define better the functionalities of the App. In the design and development the focus was on delivering a smooth visitor flow with and enhanced experience of the collection. A latter phase carried the development of the platforms from the engineering team, and the interface and the design of the service from the design side.

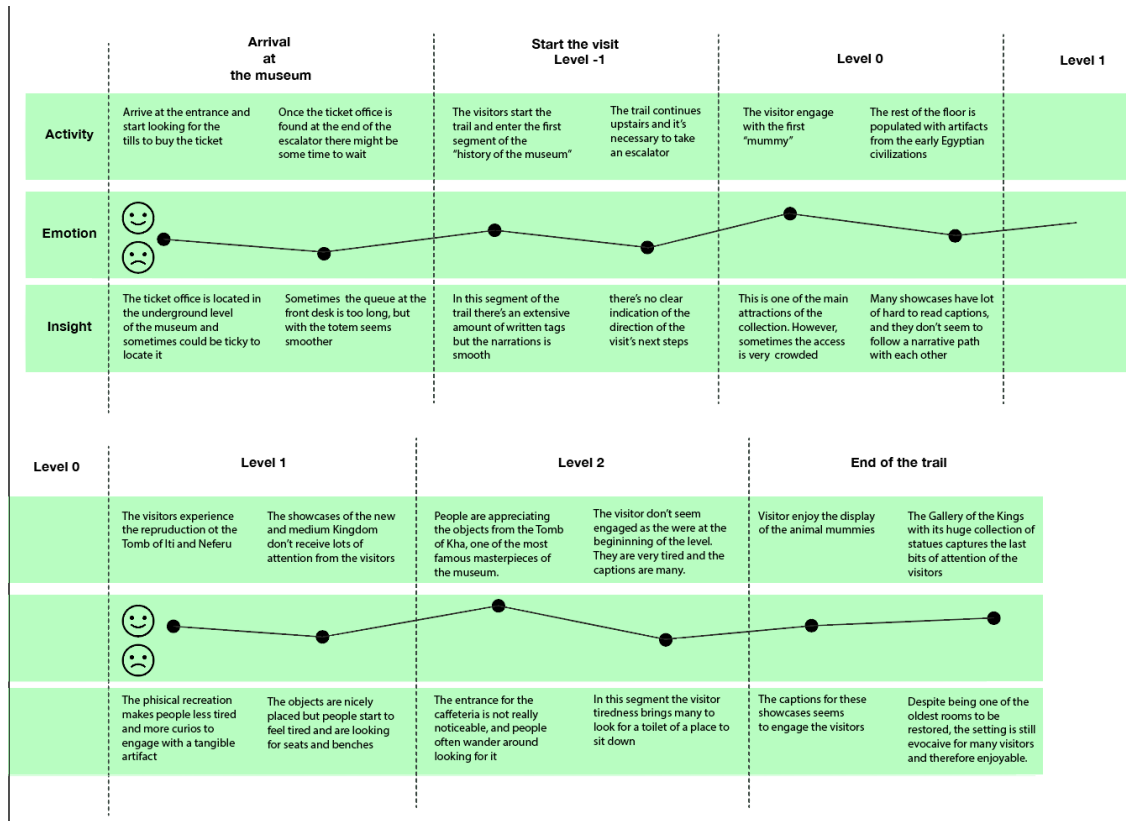


Figure 4.10: Example of the visitor journey in the museum, recreated after the findings of the workshop and the observations.

Table 4.1: The table shows the requirements and needs emerged from the discovery stage in the Museum design exploration.

Needs	Requirements
The current museum trail is too long, its distributed along 10.000 m <sup>2</sup> and it takes averagely 4 hours to complete the whole visit	manage new ways of engaging the collection
It is desirable to don't have a passive fruition of the collection	Create new museum trails for active engagement
To have interactions primarily with the objects rather than the digital artifacts	diversify the offer of visits to distribute visitor flows
Redistributing the flow of visitors (on weekdays the turnout in the museum is lower, while in the holidays it is greater)	the digital artifacts must be tools to facilitate or improve the experience

### 4.8.1 platform design and technical challenges

In order to setup an automated sensory system, we rely on low-cost common location sensors and well established techniques. In particular, for gathering information about users' location, a number of Bluetooth Low-Energy (BLE)



beacons were installed inside the museum in the ground floor, located in the “Gallery of the Kings” room, around each artefact of interest. On the visitor side, a simple Android app has been developed that senses the nearest beacon, by measuring the Received Signal Strength (RSSI) from all nearby beacons, and sends this information over Wi-Fi to a central server. In our preliminary experiments, a small number of proximity sensors have been placed in the museum, and the app is running on the visitors’ smartphone. By aggregating the positions of the visitors by place and time of day, we are able to generate heat maps containing the density of visitors around each artefact at any given time. This preliminary implementation of the sensor system is intended to show the feasibility of the proposed approach. We adopted the Bluetooth technology because, according to Faragher and Harle [40], is low-cost, and requires low maintenance efforts. In addition, this technology has been used extensively for commercial use, enabling a “new signal of opportunity with which to perform more fine-grained indoor positioning. Other indoor location methods as the Wi-Fi fingerprinting, will be less convenient to use as “*Wi-Fi is a power-hungry protocol. Bluetooth Low Energy (BLE) uses the same 2.4 GHz ISM radio band as Wi-Fi, and addresses many of these shortcomings*” [40].

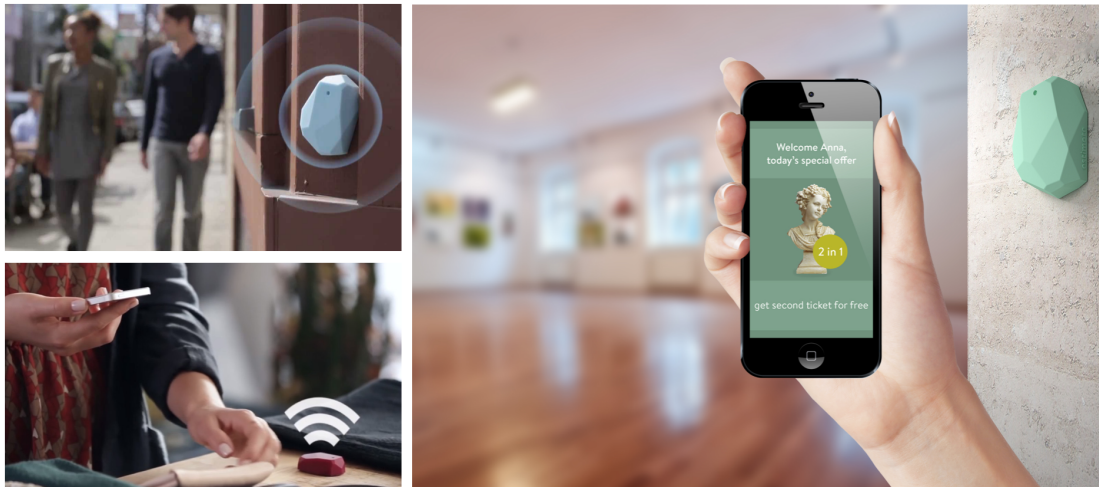


Figure 4.11: The Bluetooth technology is usually used in the retail industry. Image courtesy of Estimote

### Recommending places of interest

One important requisite is the ability to profile the visitors’ preferences in order to automatically suggest personalized tours. In this work we propose the use of a recommendation engine. The idea behind recommendation engines is that users tend to like items that are similar to other items they like, and that similar people



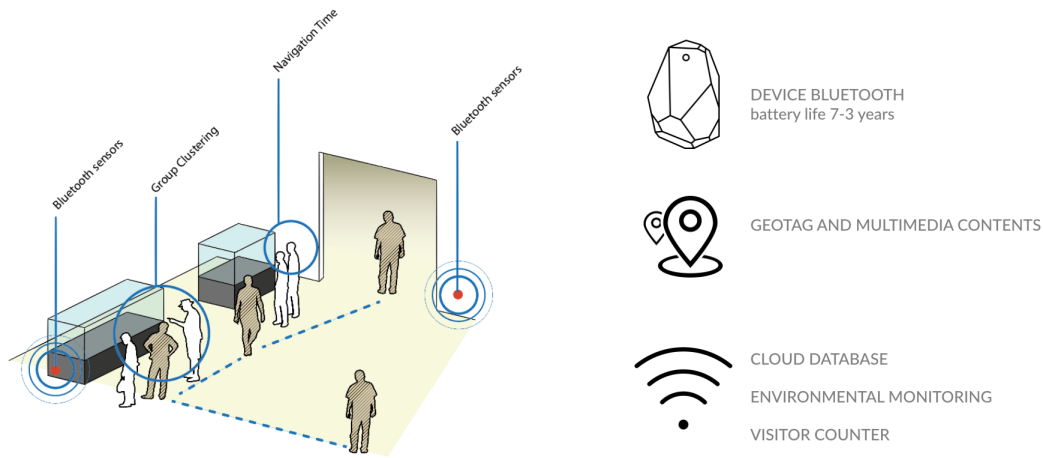


Figure 4.12: The sensor system and the details of Bluetooth technology. The image shows how the system should work with the proximity sensors placed in strategic places according to their assets

like. In a recommendation engine there are two classes of entities: users and items. The data is expressed as a so-called utility matrix, which for each user-item pair, stores the degree of preference of that user for that particular item. Values are usually integers (e.g., integers from 1 to 5 represent the number of stars that the user gave as a rating for that item). The matrix is usually sparse, since most ratings are not known. The objective is to learn embeddings that model these similarities from a set of available training data, and using these similarities to discover new and desirable things for the user.

For creating our utility matrix, we first create a list of topics of interest. Each place in the museum is manually assigned to one or more topics of interest. Then, we need to gather user ratings, which represent how much each user is interested in each topic. We use a mix of questionnaires, manual observations and automatic user location the result of questionnaires, but ideally the utility matrix ratings could be obtained by looking at how long a selected subset of test users stops near each place of interest, using the Bluetooth sensor system.

In this work we used the LightFM recommendation library [80], and in particular we use Weighted Approximate-Rank Pairwise loss (WARP), which works best when only positive interactions are available and the ratings are mostly sparse. In practice, WARP will randomly sample recommendations from the learned model, until it finds a pair of recommendations which it knows to be wrongly labelled, and will then only apply an update on the two wrongly labelled samples. At runtime, for each user we collect at least two ratings, then we use the learned model to predict a list of new topics.

### 4.8.2 Recommending alternative paths

In this study we created heat maps, both manually and automatically generated, as a two-dimensional visual representation of data in where values are represented by colours. With these visual maps we want to exploit this information in order to suggest a tour that touches different points of interest, while minimizing hypercongestion. We want to suggest a personal tour to the user that guarantees visiting most of the suggested places of interest, with the constraint that the tour should last less than a certain amount of time. Moreover, we want to exploit the data we have about the density of visitors around the artefacts for suggesting alternative paths to the user. The problem is formulated as a Shortest Path Problem with Time Windows (SPPTW), and it is solved using a label-setting algorithm, which is equivalent to solving a dynamic programming problem. In this work, we use the path suggestion algorithm to suggest a path between consecutive places of interest, trying to avoid crowded places. The Shortest Path Problem with Time Windows is a two-resources variant of the Shortest Path Problem with resource Constraints (SPPRC) problem, in which a cost has to be minimized, while a resource needs to remain bounded between two given values for each node.

We first create an acyclic directed graph composed by a set of nodes and a set of arcs connecting adjacent nodes. A weight is associated to each arc, based on walking time between the two corresponding nodes. We want to find the shortest feasible path that satisfies the constraint on the accumulated time spent over the path. For creating the graph, we subsample the floor map; each pixel represents a node in the graph, and is assigned a visiting cost. Free areas are assigned a low cost, while obstacles are assigned a high cost. Edges are created between neighbouring pixels, with a traveling cost. Moreover, each node is assigned a time resource, based in the current density of visitors in that point. The time resource represents the amount of time lost due to a high density of people. The idea is to avoid crowded places, thus suggesting faster tours. The algorithm has been implemented using a basic implementation of the SPPTW problem included in the Boost Graph Library (Boost, n.d.).

Figure 4.13 shows an example of the algorithm in action. The example shows a suggested path between a location on top of the stairs at the bottom of the map, to a location on the top of the map. The shortest path, shown in blue, does not take into account passing through an area with a high density of visitors in the middle of the left corridor.

## 4.9 Situated application and Interface evaluation

Attempting to materialize and situate intangible technology in the physical world aggregates a growing trend in field of design and technology [106]. In

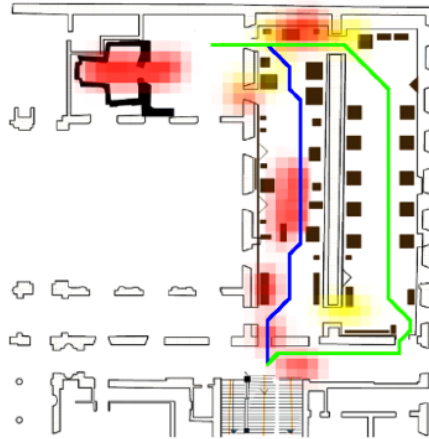


Figure 4.13: An example of the algorithm recommending alternative paths on a section of the ground floor; Blue line represents the shortest path; Green line shows the suggested path taking into account density heat map (yellow and red areas) while Red represents areas with a higher percentage of visitors

addition involving participants who designate sample of real demographics among the possible users is a good practice for designing design solutions that resonate with real human factors. Hence the last part of the experimentation was focused on make a preliminary test in situ, inside the museum, with the a number of participant devoted to test the sensor system App, and evaluating its functionalities.

#### 4.9.1 Co-design, UX prototype and interface

The sensor system prototype was tested in a lab set up at first, in a preliminary phase, and later on at the museum with more agile session. The prototype started from the customisation of a geolocalisation App merged with the SDK of the Ibeacon Estimote available on their website. The idea was to develop a sensor system that uses Bluetooth sensors with the lowest impact in terms of visit's disruption, but the highest performance on the enhancement of the museum experience. This technology is not new, since it has been implemented for commercial use for retails (Fig. 4.11). However it was interesting to investigate how to take advantage of existing technology and re-purposing it for a new design service. The design of the service included a "*double functionality tool*" that was meant to act as a monitor system for giving insights on the visitors behaviour on real time, and on the end users side, to give help in way-finding and hints for a more personalised visit experience.

The insights on the visitors behaviour included information in real time on where do they usually cluster and where the people flow was more congested, in

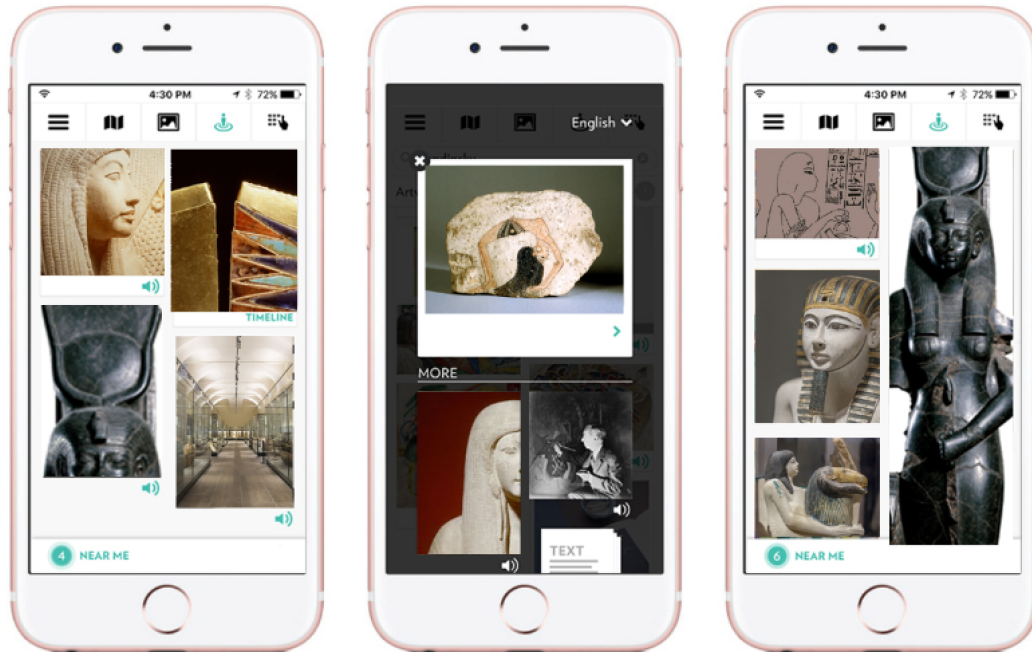


Figure 4.14: The interface prototype for the museum trails app.

addition to the understanding of which kind of masterpiece were most visited, and how much time do people averagely spent around the showcases.

In general, the App service purpose is both intended as business-to-business (B2B), since it has been developed from the TIM company and the University for the museum institution, and business-to-consumer (B2C), because the ultimate functionalities are developed to help the visitors/consumers to enjoy their visit.

### **Trial Lab testing - preliminary stage**

The trial lab testing was set up in order to monitor mostly the efficacy of the Bluetooth sensors on giving precise details on the position and the transit of the users holding the mobile phone, and to set up the proper calibration that would allow to monitor efficiently the position of the user with the minimum amount of battery energy from the sensor. The preliminary test included ,apart from the Ibeacon sensors calibration (Fig. 4.15), the user testing of pivotal variables, such as usability, accessibility and over all how easy was to use the app to monitor the behavioral pattern of users. The tests were not structured but they were based on the observations and the interviews with 22 participants aged between 21 and 50 years old. The observations of these gathered comments and insights from the participants that have been later used to improve usability and technological aspects

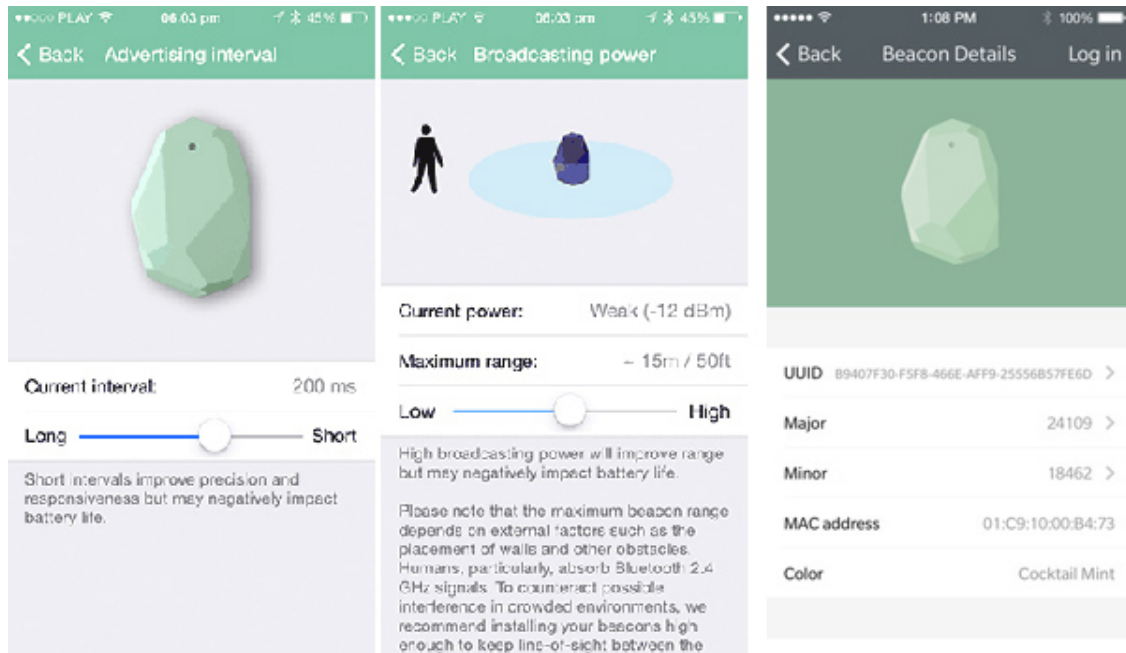


Figure 4.15: Estimote beacon calibrations. Images courtesy of the Estimote App. In these screenshots it is possible to visualize the actionable range of use for each beacon from the Estimote proximity App.

of the App. Thanks to this preliminary lab test it was possible to recognize some weaknesses in the system, and proceed with the further development of the program. The early limitations that emerged during the test were linked to the ability of the sensors to effectively report the real position of the user, since it was not possible to use 3 sensors together and make a triangulation in a given space, the sensors have been later placed just next to each other in a sequence for optimal use. In addition, the early version of the App interface included too many functionalities that were creating confusion among the participants, in fact one of those said *"I wish I could use one feature after another"*. This statement was triggered by the fact that each participant had to wander around and check the smartphone at the same time. In addition, other participants stated that "Using the interface was nice, but sometimes too many colors could distract from the meaning of each button" and that "the icons sometimes were nicely designed but not so easy to connect with the precise purpose". For this reason in the latter interface the color palette has been reduced in the amount of use of colors, and where possible the icons employed in the interface were the same used in the Google Material Design [51].

### Interface and accessibility issues

As introduced in the previous paragraph, the guidelines emerged from the preliminary lab test have been of great importance in giving hints to improve the

interface accessibility and usability.

Since the end user would use the App to find the shortest path and get to navigate inside the museum while enjoying the objects and not being too distracted with the smartphone, a very minimal and basic layout has been chosen. The real hidden feature of the App is the ability to suggest the shortest path and avoid overcrowded rooms. This feature is supported by a specific Algorithm designed to recommend alternative paths, as shown in Fig. 4.13 In addition, the recommendations are based on the available given time decided by the user at the beginning of the testing section. Moreover from the museum professional's back end there was the possibility to check the most visited artifacts and the stats about how much time was spent from the visitors around the triggering points.

#### **wireframing the prototype**

### **4.9.2 the situated experience**

The situated experiment took place in just one floor of the museum, since the full extension of the permanent collection spans over 10.000 m<sup>2</sup> and it would have been troublesome to apply the wayfinding algorithm over the full extension of the display for the situated experience. Therefore in this situated experiment only the floor that hosts the artifacts from the Tomb of Kha has been taken into consideration, since the nature of these displayed objects is very known to a wider range of public, and represent an iconic piece of the collection.

#### **Participants**

The selected participants for this experimentation were 20, divided in 4 groups for the prior 4 sessions of the experiment. The demographics of the participants were included among 26 and 65 years old, 11 females and 9 males. Among them, 8 were visiting tourist from outside town, while 12 were citizens from the city of Turin. Between the participants, 15 people didn't have the chance to see the museum after the huge renovation, while the other 5 already spent one day at the museum in the days after the inauguration in 2015.

#### **The App experience journey**

The test with the platform were meant to be an integration of the museum experience for the visitors who did not choose to engage with a museum guide. The use of the App was tested in 3 session in the morning and 1 in the afternoon of the same day. In the morning sessions the users were using the App prototype, while in the afternoon, the control group was roaming freely without any device. The App was running on the participants personal device (bring your own device - BYOD - policy) in order to both test the compatibility with different kind of



Android smartphones and minimize the literacy disruption derived from the use of an unknown device. By letting the user engage with their own device we wanted to both test the usability of the App without the bias of using a different smartphone than the usual one. For each participant using the system, was required to download the App prior to the start of the visit, and then begin to use it in the designated area (Tomb of Kha). In this area, 12 sensors have been distributed, in order to both gather data on the visitors navigation, and supply the visit experience with pop-up notifications about history behind the showcased objects. The participants were able to enjoy or not the extra content on the museum artifacts by tapping on the "near me" command on the screen. Without that it was possible to just visualize an optimal trail with the available time set at the beginning of the experience.

To sum up, the setup was tested in two ways: one with the App running for the Tomb of Kha, with the possibility of enabling the artifacts insights, and the other without the App, to have an environment without any design intervention. The study was designed to observe how people were engaging with the sensor system, and if they benefited from its use. In particular little introduction was given on how to use the on purpose, since the natural usability of the system was one of the main features observed. The experiment's observers were 2, and made sure to fill observational form that were integrative of semi-structure interviews performed by a facilitator at the end of the experience.



Figure 4.16: The set-up of the Bluetooth Proximity sensors

### 4.9.3 Data collection

The situated application was crated to observe and evaluate the solution designed to enhance the museum experience: the sensor system with the mobile App. During the trial, the purpose was to evaluate single features of general

### engagement

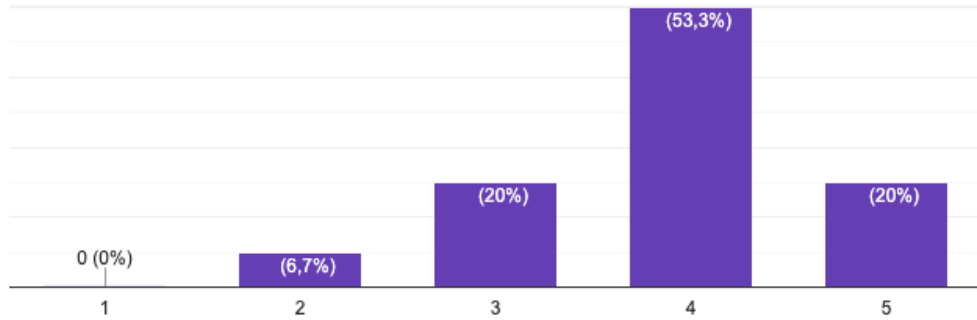


Figure 4.17: The figure shows how generally the engagement in the visit experience reached a peak on point n.4, indicating from 1 as the less enjoyable, and 5 the most.

### content fruition

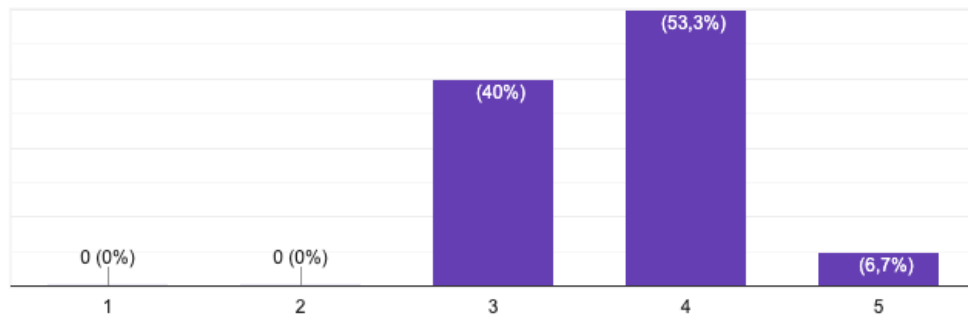


Figure 4.18: The figure shows how generally the perception of the content delivered with the App has been welcomed. Also in this case the result is almost at the top positive, but a 40% in the middle around the value 3, indicates that still some improvement could be done for making the content more understandable.

usability, efficacy in supporting insights on given artifacts, improved wayfinding, and in general less stress from the visitor side. On the back-end side, from the developers perspective, was important to evaluate how the algorithm was able to work in real time, and if the heatmaps from the preliminary observation phase



Fig. 4.8 would have been able to generate automatically.

In addition, more specific assets have been taken into account for evaluating both the usability and the engagement of the solution, which should be two requirements for the enhanced museum experience [38].

The data collection has been performed by delivering questionnaires at the end of the situated experience, alongside a semi-structured interview. These data were then checked with the observations material gathered by the researchers in situ.

The delivered questionnaire has been crafted on the base of the Laugwitz model of the User Experience Questionnaire (UEQ) [81]. The inquiries were divided in two main sections, one specifically focused on the App evaluation, and therefore given just to the participants who used the App, and a the other section, for all the participants, including the ones using and not experiences the App. This decision was taken in the light of evaluating how the visiting experience will effectively benefit from the use of the sensor system. The Questionnaire used a likert scale 5 point, in which 1 was corresponding to the most negative feeling, and 5 was attributed to the most positive. As noticeable in table 4.2, the results of the usability of the App are quite promising. Still the interface presents some issues in the legibility (AV 3,47), but the overall perception results very positive (AV 3,80) with a very low standard deviation (SD 0,56).

In addition to the questionnaire, observations and and semi-structure interviews highlighted some issues related to the time management. As an example, Participant n.5 said *"the time management I was given with the App was nice, but at the same time getting to know that some gorgeous art is in the next room is painful"*. This means that sometimes the available time and the space that the visitor has to walk along could be disruptive in terms of not facilitating the decision making of the user. An Other participant stated that *"during the use of the App, sometimes the notifications were distracting, but I do understand there's no other way to convey a visual/written message while the phone is operating in stand by mode"*. In this case it seems that the nature of the visual data for the artifacts insights that were popping up in the proximity of the sensors could derail the user attention from the art to the smartphone. Participants in general commented that it was easier to navigate and roam around with the help of the App, but in general issues with the usability could make it more hard to enjoy the experience.

## 4.10 Limitations and reflections for further development

This project has been designed upon the previous requirements and needs that appeared during the Discovery stage. Later on, the solution to adopt a wayfinding algorithm paired with a Bluetooth sensor system, to both monitor visitors

App Evaluation Results			
Attribute	Category	AV	SD
learnability	difficult to learn/ easy to learn	3,73	0,80
engagement	annoying to use /enjoyable	3,87	0,83
usability of the interface	complicated / easy	3,47	0,74
content fruition	difficult to read / easy to read	3,71	0,62
attention to the artefacts	app was distracting from the art /it was not distracting	3,07	0,80
perception of interface	confusing / clear content	3,80	0,56
Experience Evaluation - with the App			
Attribute	Category	AV	SD
navigation	hard to navigate / easy to navigate	4,07	0,80
wayfinding locate toilets and cafeteria	difficult / easy	4,53	0,52
collection - locate artifacts	difficult / easy	4,40	0,63
time management	difficult / easy	4,20	0,68
Experience Evaluation - without the App			
navigation	hard to navigate / easy to navigate	2,40	0,55
wayfinding locate toilets and cafeteria	difficult / easy	1,80	0,84
collection - locate artifacts	difficult / easy	1,80	0,45
time management	difficult / easy	1,20	0,45

Table 4.2: The results of the Questionnaire delivered after the situated experience in the museum. A striking difference is noticeable in the section for the Experience with and without the App. The abbreviations are standing for Average (AV) and Standard Deviation (SD).

behaviour and help them achieve an enhanced experience of the visit. However, the whole project is at an early stage and could be easily picked up and taken a step further by further research and development. In fact, bits of this work have been taken into account for the next chapter experimentation, that included a more sophisticated level of digital and service design crafting.

This project has built upon the previous wayfinding algorithm project, and we believe it can be easily picked up and taken a step further by our successors. There is quite a bit of work to be done before this project can become a real product for Museum visitors. Next steps in fact, will include a more extensive user-testing for the prototype, but from an implementation point of view few steps further will be taken into the addition of new functionalities, such as audio narratives instead of just image/text based insights. Variation in term of the content offer, could lead to a more personalised experience of the visit, but also, to spike the attention toward the artefacts.

#### **4.10.1 Public spaces and decision making**

The evolution of the study, lead to the next chapter in an exploration in a public space context such as the urban environment of Central London. This new context is still linked to the Museum experience by the fruition of the CH content, in a more leisure oriented way. Before the concept of "roaming freely inside the heritage space" has been started to investigated, but in the next chapter is analysed more deeply. Specifically in relation again with personal engagement, but more broadly with the concept of easing the decision making process in visitors.

## Experiences - 2nd design exploration

This project, and its design exploration reported in this thesis, are part of a H2020 project conducted in partnership with different Academic institutions around Europe, such as the Imperial College London (ICL), the Greek museums network of Piraeus bank group cultural foundation (PIOP), the Universidad de Malaga (UMA) and, the East Slovakian Museum (ESM). Also, other commercial oriented institutions have been involved in the project, such as Clio Muse, developer of virtual tours and, XTeam Software Solutions.

**The goal of this project called Pluggy is to create tools that will be possibly lead citizens to be actively involved in cultural heritage, and engage them as creators and curators by sharing and shaping a new perception of Cultural Heritage (CH).** In fact, the concept of CH is taken here to a new level, where its fruition is made in the everyday of people's life, using tools that are part of the day to day activities such as smartphones, Apps, and web accessible sites. But the goal of Pluggy is not just to engage with CH in a virtual way, since every designed tool is meant to be an implementation of a real environment. As a matter of fact, in this project was used Augmented Reality (AR), instead of Virtual Reality, and the specif concept tested in the following sections of this chapter will highlight the use of location based tools and the lessons learnt from the previous chapter for a new geolocalisation tool. In addition new ways to convey cultural content will be included in this experimentation, such as User Generated Content (UGC), and the creation of audio narrative paths.

### 5.1 2nd Design Exploration - Kensington Gore Urban Heritage

<sup>1</sup>

The aim of the Pluggy project is to test potential design spaces for social

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<sup>1</sup>parts of this chapter are under revision from IC London for future publication

media and technology [119], while highlighting issues and opportunities in involving people in cultural heritage. This exploration investigates how current social media could further be utilised using arguments informed by findings from semi-structured interviews using critical theory, and from a specific case study evaluating the user experience of 'conventional' audio narratives vs. user-generated audio narratives around British Architecture in London as part of the PLUGGY project [87].

### 5.1.1 Introduction

Heritage has a compelling role in postmodern tourism, and specifically toward the built heritage, that according to Nuryanti can be defined as *"the heart of cultural tourism"*[111]. However, the relationship between tourism and heritage present some frictions, that are usually emerging in the juxtaposition between tradition and modernity, globally known and locally known. In this sense, built heritage can be used as an artefact to promote ethics, history, or industry, but can be experienced by visitors through a narrow understanding of time and place. Architecture can be an immersive space into the history of the city, but the general lack of knowledge toward architecture prevents people to engage with the built environment. An intriguing perspective is that architecture could act as a common ground that is usually shared by a mixed public, including tourists, employees, and locals, while limited information is available to contextualize the artefacts. The square at Kensington Gore contains such built heritage allowing views of historical buildings and monuments. Therefore, there's a chance to broaden a narrative experience that acquires meaning thanks to the public contribution, which opens interpretations and links to other urban landscapes (i.e., architectural artifacts are often related to artefacts displayed in museums or other buildings in other cities). The architecture or artefacts of interest for this study are the Royal Albert Hall, the Prince Albert Sculpture (The Great Exhibition Memorial), the Royal College of Music Building, the Albert Court, and the Beit Quadrangle.

## 5.2 Processes and project roadmap

The methodology applied in this design exploration is a merge of the RtD approach and the mixed UX methods, previously introduced in this thesis in Section 3.2.

The liability of this approach resides in the adoption of a roadmap that envisions from the start which steps are meant to be made in each phase, Fig. 5.1. In particular, the Iterative exploration has been designed to take into account

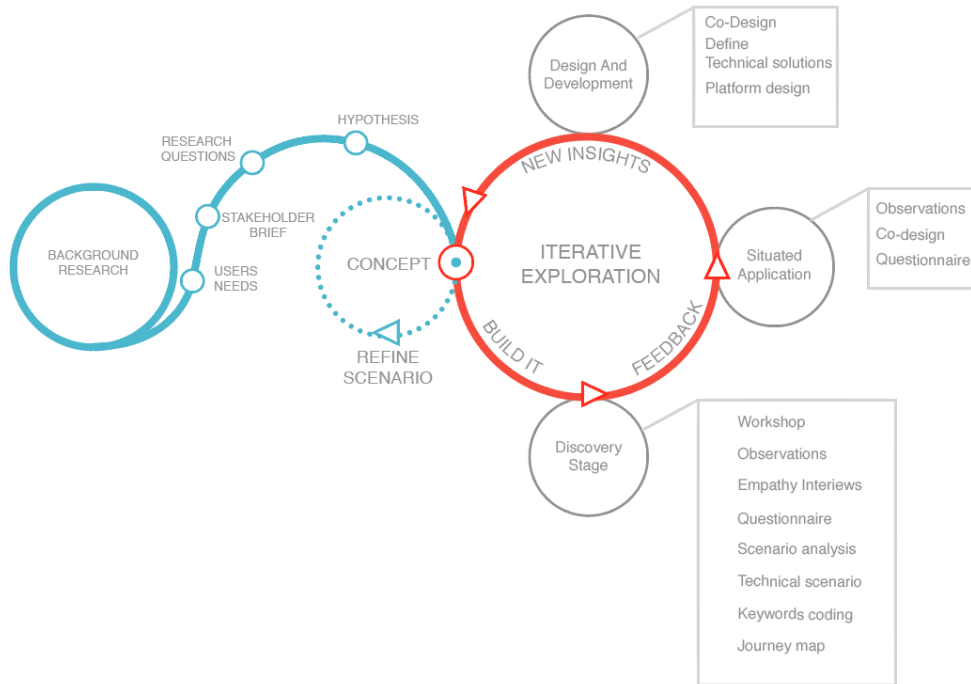


Figure 5.1: The process of the 2nd design exploration. This scheme illustrates the road map of the research action performed.

simultaneously different variables, in order to get track of changes in the needs and the scenario, but most of all, to envision the whole picture in its complexity.

### 5.3 Concept of the social platform and ‘pluggable’ Apps

The concept of Pluggy is a social platform composed by different pluggable mobile applications. These applications, alongside a ‘curatorial tool’ that allows people to curate and share their personal content linked to CH, are focused in engaging citizens in creating and protecting heritage around Europe [118].

The content for the curatorial tool will be both crowdsourced, shared by the users who will upload User Generated Content (UGC), and sourced from public digital collection and professionals in the heritage field. The interaction with the platform, could be the trigger for *"allowing users to create links between seemingly unrelated facts, events, people and digitized collections, leading to new approaches of presenting cultural resources and new ways of interacting with them"* [118].

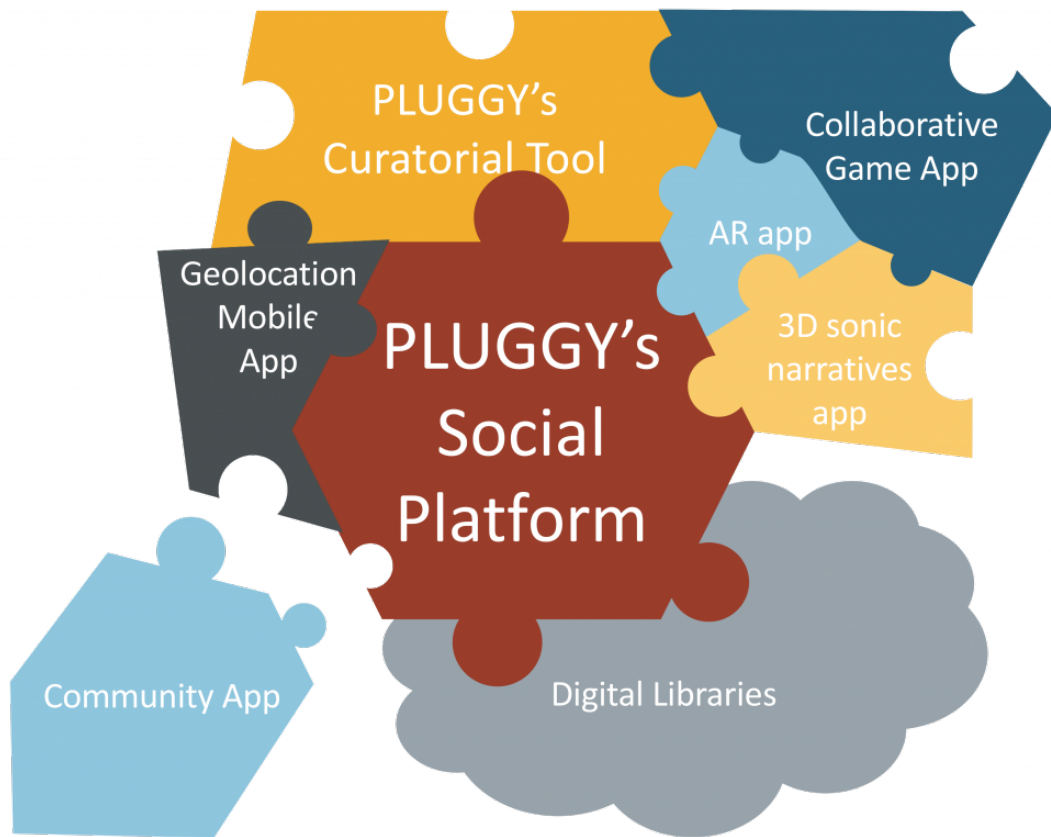


Figure 5.2: The Pluggy social platform concept's scheme. This social platform is meant to be a puzzle composed by mobile and web app with diverse functionalities and assets.

Since the core aim of Pluggy is to create awareness toward heritage in the everyday, users will be able to interact and to create themselves virtual exhibitions and interact with geolocated content on the territory.

However, in this thesis, will be reported a situated study aimed not at testing the whole apps, but focalizing on the features of the first three ones. Since the whole project that covers the whole social platform spans over 3 years, at the time of this experimentation was possible to test the functionalities of the geolocalisation App, and the Audio narratives with the technology of the Augmented reality tools [5.3](#).

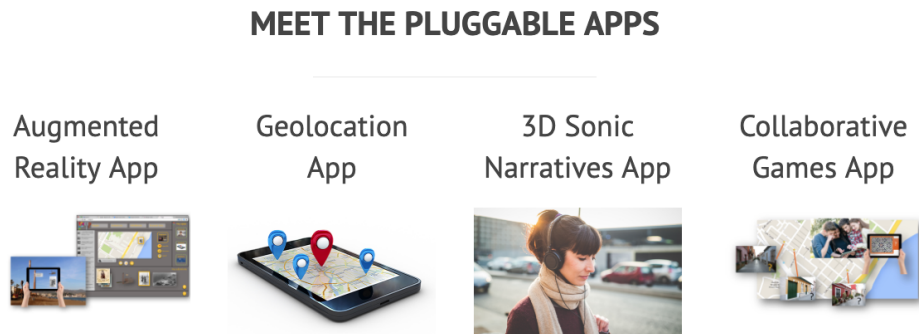


Figure 5.3: The Pluggy social platform concept is composed by 4 main mobile Apps: The augmented reality App, the geolocation App, the 3D sonic narratives App and the collaborative Games App.

## 5.4 Understanding the Built environment: the Kensington Gore case study

Recent studies of cultural heritage and tourism associated the broader meaning that historical values from the past carry on nowadays [111]. The concept of tourism, instead is a model of contemporary knowledge, with a dynamic nature in a form of a modern consciousness [111]. According to Nuryantil, the interaction between CH and Tourism often results in a reinterpretation of the latter.

In a nutshell, the connection between heritage and tourism corresponds to the debate that is created around society's culture between tradition and modernity. The aim of this project brought many research questions related to the visitors/tourists engagement in a public cultural heritage. But given the concept of Pluggy, as a large scale social platform, was essential to test with situated application few features at a time. For this reason, was selected the Cultural area of the Kensington Gore square, as a venue for the situated application. The square is the place of significant Architectural heritage from the Victorian Age, and hosts a series of historical buildings and monuments such as the Royal Albert Hall, the Prince Albert Sculpture (The Great Exhibition Memorial), the Royal College of Music Building, the Albert Court, and the Beit Quadrangle. In addition Kensington Gore is a strategic place where a huge flow of tourist transit everyday, and most of the time accidentally bumps in clueless after a visit a the very close by museum quarter in Exhibition Road, or a stroll in Hyde Park.

The Built environment heritage could potentially connect in a wider dialogue with artefacts located in museums, and other buildings in other cities (i.e. the Royal College of Music has a huge influence from Dutch architectural landscape, while the Albert Court was commissioned to Frederick Hemings c. 1855–94, Victorian



architect that was strongly influenced by the German Urban development). In this sense, the design solution is aimed at testing how to connect people with the Urban heritage, but also, how to engage them in a more active dialogue toward CH at large.

## 5.5 Analysing the cultural experience with the help of UX

The visitor experience that takes place in the Urban environment is totally upon the serendipity of the casual discovery of the cultural site [orbasli2002tourists]. Therefore, this experience is more leisure oriented, rather than learning oriented. This case differs in few aspects from the 1st design exploration, such as the virtual absence of a properly declared cultural environment such as the museum, and the total absence of any suggested way on site on how to engage with the surroundings. For this reasons, instead one of the touch points with the previous experiment are the need of wayfinding, that in this place is even more loud, and the fatigue and stress from an entire day roaming around museums and monuments in the city of London. The methods used to analyse the tourist experience in this site shifted on the qualitative side, and included a deep empathy study, such as the interviews and their coding, and a more ethnographic approach, such as the observations. The UX methods helped to shape the iterative process toward the concept of the Geolocalisation and the Audio narrative App, since for depicting a more precise evaluation of specific functionalities under the umbrella of the Augmented reality technology.

### 5.5.1 Augmented reality mixed environment

With the term Augmented Reality (AR), in this research is intended a field of expertise that merges various technologies, but brings them ultimately to a real world, without creating solutions that are completely virtual. AR is a field regarded by numerous people as a subfield of the broader concept of Mixed Reality [27], but its versatility could modify significantly how we *"interact not only with computers but also with the real environment surrounding us, as well as with other human beings"* [27]. This technology has extensively been used for purposes linked with military training, medicine, maintenance, architecture and urban planning, tourism, and entertainment. According to Damala [25], this technology has the potential to change the way heritage could be perceived. The augmented reality approach has been discussed in a series of cases presented in this thesis in Section 2.6, and it brings on the table potential benefits for the Augmented Reality community as well as for cultural heritage professionals.

### 5.5.2 Ubiquitous design and spatial applications

The outdoor nature of this design experimentation put into high priority the concept of spatial planning for ubiquitous design. In addition, the nature of information technology and smart digital solutions, are having a significant effect on contemporary urban and regional planning [83].

Information and communication technologies are evolving cities from virtual city, which reproduces urban elements inside the virtual computer world, to ubiquitous city, where the ubiquitous computing amongst urban elements such as people, buildings, infrastructure and urban space is available. Nevertheless a strategic ubiquitous city planning is yet to be addressed in an integrated manner by planners and regional analysts because the technologies and applications still need to be fully developed. According to Kidd [73] *digital technologies are evolving cities from virtual city, which reflects urban elements inside the virtual computer world, to ubiquitous city, where the ubiquitous computing amongst urban elements such as people, buildings, infrastructure and urban space is available* [83]. This research examines complex implications of integration in spatial planning / spatial development processes. Previous designed frameworks for integration (e.g. Kidd [73] ) will be used to create a new interpretation of the applications in spatial planning [143]. The challenge in this project was that even if integration is a fundamental issue in spatial planning, the real applications of the concept in relation to different planning methods and in diverse stakeholders point of view are still vague. Therefore, based on the frameworks for integration, the paper assesses the comprehensiveness of the integration concept in spatial planning, thereby taken into account that not all planning objectives require integrative planning processes. Therefore, based on the frameworks for integration, the research evaluates the integration concept in spatial planning, from an iterative point of view, sorting out which planning objectives require integrative from the beginning of the planning processes, and which one does not.

## 5.6 Iterative exploration

As anticipated in the Chapter. 3 of this thesis, the iterative process has been adopted in the situated application as a mean to gain actionable insights during the prototype development. In this sense is possible to save time, and integrating important human factors such as accessibility and usability. But also in this situated application, accessibility is paired with the empathic understanding of the users needs. In this specific case study, that took place in a urban environment, was important to grasp the tourist behaviour into an unknown environment.

This research took into account findings from the iterative stage not just to validate the functionalities of the prototype, but to even shape its very purpose.

The adopted procedure was pivotal to proceed with the co-design of the social platform tools.

## 5.7 Discovery stage

The Discovery stage is an important step that is aimed at investigating assumption linked to visitors needs, as anticipated in Section 4.6.

However, in this 2nd design exploration, the discovery stage has been devoted to reveal the factors that depict more in detail the scenario, such as a vibrant cultural diversity, new social media and their way of intervention, and the importance of the user generated content to target users' engagement.

These preliminary insights from the scenario analysis have emerged with the empathy interview, the observations, and the co-design workshop.

### 5.7.1 Cultural diversity and digital media

In the traditional view of cultural heritage, people valued material things with intrinsic properties or a national history. The traditional paradigm encouraged the reduction of heritage to tourism and consumption with the engagement of broader cultural topics only for a professional audience. Recently, however, a new paradigm emerged, which puts the production of heritage to the foreground. The new paradigm aims to encompass greater democratic participatory action, with greater concern for the local and the everyday. Generally, it has been argued that heritage that is everywhere, and relevant to our everyday life, is likely to be one of the preconditions for genuine sustainability. This stresses the importance of heritage communities which are social groups who value specific aspects of cultural heritage which they wish to sustain and transmit to future generations within the framework of public action [24]. Hence, citizen participation is considered an ethical obligation and a political necessity to strengthen democracy and creates governance that can improve quality of life.

Some key examples of enablers of the paradigm shift are *policy*, *inclusivity* and *technology*. Firstly, the role of culture as a component of sustainable development is being increasingly discussed in policy debates. UNESCO emphasised the importance of culture during the Decade of Culture and Development (1988 - 1998) and through its Conventions (e.g., on the Protection and Promotion of the Diversity of Cultural Expressions in 2005; for the Safeguarding of the Intangible Cultural Heritage in 2003; and concerning the Protection of the World Cultural and Natural Heritage in 1972). In Europe, both the Council of Europe's Landscape Convention and its Faro Convention imply more culturally-sensitive approaches [37].

Secondly, heritage is often represented by places linked to the built environment that is already iconic, but not really representative of all the sides and transliterations of a culturally diverse audience [152].

One key aspect in being understood by the audience is to find a common root between different cultures, and globalize what at the moment is only locally known [155]. The challenge here is to contextualize masterpieces, cultural landmarks and pieces of the built environment to a cultural diverse panorama. Cultural artifacts are rarely located where most people live or work, "here". Too often they are — it seems almost by definition somewhere else, "there". People might visit them on holiday, but this type of heritage is not part of the everyday landscape of their normal lives. If heritage is thus defined as elsewhere, there is a risk that it will unintentionally become an instrument of exclusion. It can only become an instrument of inclusion and commonality if it is defined contextually as local, lived-in, ordinary, and if it is recognised as an element of both shared identity and differentiation [117]. According to Giaccardi, contemporary heritage studies are the results of ongoing interactions in the lived world of ordinary people [49].

Thirdly, because of careful planning of mobile technology manufacturers and operators we have reached an always-connected society [48]. The combination of ubiquitous access to multimedia content and information with the consolidation of distributed curation, creates great opportunities to develop technological tools to further enable this paradigm shift in Cultural Heritage.

## 5.7.2 Distributed Curation in Social Media and HCI

Distributed curation is a phenomenon by which citizen communities have accepted to freely provide content and information [64]. Digital and social technologies are facilitating distributed forms of curatorial practice, which can be harnessed to democratize history [88], in turn supporting inclusivity and policy. Liu [88] describes distributed curation as a socio-technical practice involving people, cultural artefacts, and information and communication technology. It's a collaborative and distributed practice, creating shared ownership over the stewardship of the living heritage through transparency, which further allows other parties to partake in the curatorial process.

There have been a number of recent projects in HCI that aimed at supporting distributed curation using social media. One well-known social media channel, generally accepted and used by communities, is Instagram. Instagram allows creative practices from non-elite social contexts and communication that relies on everyday competencies rather than a formal artistic education (Burgess, 2006 as

described in [159]), extending the reach of the museum beyond its walls. Another example is the CURIOS project [157]. CURIOS researchers explored how digital archives for rural community heritage groups can be made more sustainable so that volunteer members can maintain a lasting digital presence. They developed software tools to help remote rural communities to collaboratively maintain and present information about their cultural heritage using open linked data. This approach is attuned to the specificity of a local heritage but can also take advantage of already collected materials from elsewhere. In another example, Yelmi et al. [166] evaluated soundscapes as an intangible cultural heritage element and introduced the Soundsslike Project. Soundsslike is a crowdsourced online sound archive which invites people to record symbolic urban sounds and upload them to the online sound archive. This online platform was built and displayed in an exhibition by means of an interactive table top interface to learn more from users and contributors, and to enrich the archive content by raising public awareness of urban sounds.

Distributed curation has also shown helpful in personalizing experiences. For example, MobiTag [23] is an electronic guide that supports semantic, social, and spatial navigation in museums by allowing visitors to create and vote for tags. Han et al. [55] developed a mobile application called Lost State College (LSC) and showed that users utilized social features as a way of learning local history and interacting with others, co-creating digital traces and rich layers of local history information. Users shared information using social features, which allowed different ways of connecting to the local history. McGookin and Brewster designed PULSE [98] which allows users to gain a vibe (i.e., an intrinsic understanding of the people, places and activities around their current location) using Twitter data. As users moved, PULSE downloaded public messages (tweets) generated by any user in the current location. Then, PULSE would select the closest tweet and insert it in a virtual 3D auditory environment: users heard tweets as whispered conversations. Bellens et al. [10] explored how social media data can be employed to study tourism on European Cultural Routes and showed its potential for investigating a complex touristic object such as a cultural route. They combined text related to photos on Instagram with Wikipedia for geographical places. This allowed them to identify the most popular stops and localities related to the cultural route. And Bujari et al. [20] proposed PhotoTrip, an interactive tool able to autonomously recommend cultural heritage locations along travel itineraries even if those locations were not mainstream. PhotoTrip identified points of interest by gathering pictures and related information from Flickr and Wikipedia and then providing the user with suggestions and recommendations.

With these examples, we see that communities are being more and more involved through distributed curation where technologies mediate and allows

them to contribute to our histories. The results of these projects and current use of social platforms have demonstrated their potential to build networks through the individual and distributed contributions of users. To our knowledge, however, their possibilities have not been fully exploited with regard to Cultural Heritage promotion and integration in people’s everyday life. We believe, distributed curation is still limited in the cultural heritage sector.

Most of the time, tourists deal with specific tourism related agents and locations such as tour guides, desk clerks, taxi drivers and rarely merge with the surrounding community [63]. Mass tourism can create a barrier between visitors and locals. It is therefore not surprising, that there is a wide range of new concepts like ‘sustainable tourism’, ‘resident responsive tourism’ and ‘community based tourism’ have become important. Visitors are in constant need of help in finding relevant information, but providing them with appropriate information is challenging because their interests and needs are unknown [3].

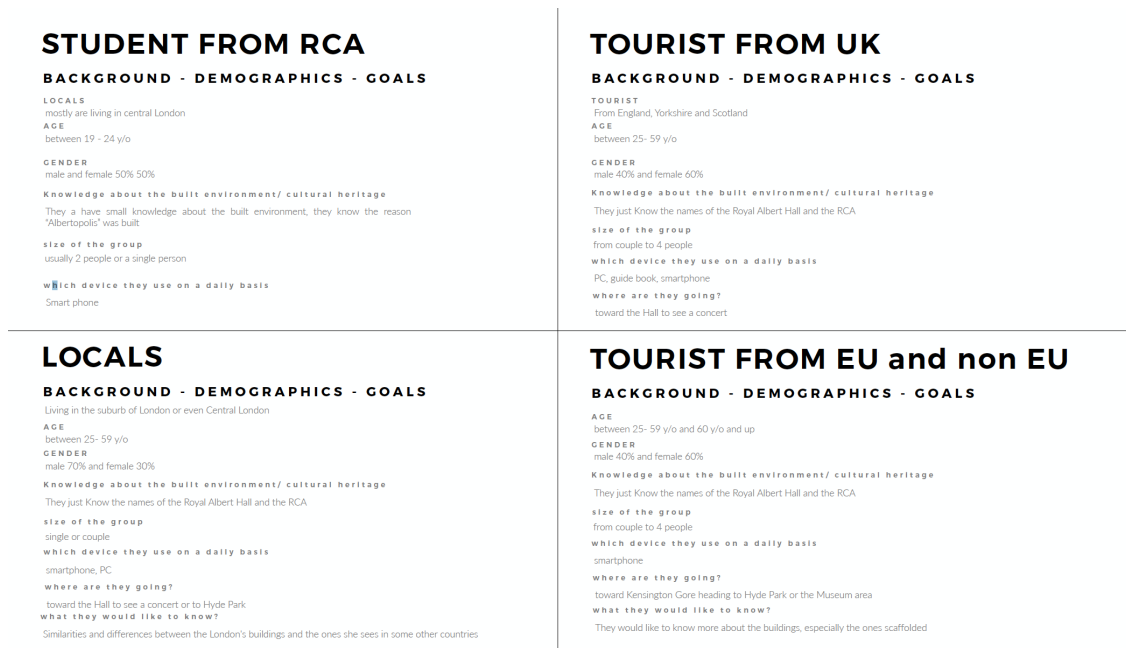


Figure 5.4: The personas of the users that populated the area of Kensington Gore

### 5.7.3 Observations and Personas

The observations conducted at the very early stage of the experimentation allowed to depict a clearer scenario of the actual visitors and tourist that populate the area of Kensington Gore. After 1 month of 1hour and a half daily sessions of manual observation, it was possible to define the Personas of the users (Fig. 5.4).

The main personas depicted were:

- Locals
- Students from the Royal College of Arts
- Tourists from the UK
- Tourists from the EU and extra EU

#### 5.7.4 Interviews and coding

The research goal was to have a better understanding in the role of current social media and ICT, and provide implications aiming at support participation and inclusivity, where we can perceive heritage as something that is here. We conducted in-depth, semi-structured and audio-recorded interviews with 22 participants in the period between April and October 2017. The interviews lasted 30 to 90 minutes and took place in a museum or online using Skype. Participants included cultural heritage professionals and general audiences. See Tables 1 and 2 for participant demographics.

Cultural heritage professionals varied in occupation: head of media, curators, guides, administrators, managers to an architect, economist and journalist. They all worked in either museums, galleries, or independently, within the field of heritage. We used an interview protocol with questions covering themes like personal background, project activities, their motivations, goals and challenges, and social media and ICT use. Other key themes were on their views of what the future should bring in terms of experiences and the role of technology.

General audience participants included post-graduate students, researchers, a developer, founder, account assistant and manager, who generally do not engage in cultural heritage activities as part of their work. Again, we used an interview protocol with questions but covering themes like personal background, recent cultural heritage related activities they have participated, social media and ICT use, their motivations, goals, and challenges.

The analysis of the interviews was conducted in steps involving gradually identifying emerging themes in the data. First, interviews were transcribed verbatim. Then, transcription items were selected for relevance to our goal in understanding current issues in social media and ICT for cultural heritage. Only relevant items were used for an initial high-level categorization, which are the three stages (i.e., discovery, experience, and transmission) we have identified as presented in the findings below. For each high-level category, items were further categorized and coded.

Transcriptions were coded individually and then discussed collaboratively. The MAXQDA qualitative analysis software was used to map the frequency and relevance of codes.

<b>Name</b>	<b>Gender</b>	<b>Occupation</b>	<b>Country</b>
Alfred	M	Head of Media	UK
Bea	F	Curator, Professor	UK
Carl	M	Museum guide	Slovakia
Diane	F	Museum guide	Slovakia
Edward	M	Project Manager	Slovakia
Fabio	M	Journalist	Greece
Gina	F	Museum administrator	Greece
Hailey	F	Curator, Manager	Greece
Isaac	M	Architect	Greece
Julia	F	Economist	Greece
Karen	F	Museum administrator	Greece

Table 5.1: Participant demographics of cultural heritage cultural heritage professionals with pseudonyms.

<b>Name</b>	<b>Gender</b>	<b>Occupation</b>	<b>Country</b>
Luuk	M	PhD Student	UK
Mandy	F	Master student	Portugal
Nico	M	Master student	Slovenia
Oscar	M	PhD Student	Portugal
Pascal	M	PhD Student	Ireland
Quin	M	Developer	Portugal
Ralph	M	Researcher	UK
Tarah	F	Founder	Greece
Ursa	F	Account Assistant	Greece
Victor	M	Project Manager	Greece
Willa	F	Retired	UK

Table 5.2: Participant demographics of general audiences with pseudonyms

### 5.7.5 Interviews Results

We collected and transcribed a total of 930 minutes of audio-recorded interviews (approximately 27500 words). A total of 283 items were identified, but 165 items were categorized to fit within 3 overarching themes selected for discussion in this paper. As other items were much less frequently mentioned, we



did not consider it as empirically relevant and are therefore left out of the analysis. The overarching themes we identified foregrounds opportunities or implications for further exploration in *redefining the expert*, *extending the experience space*, and *decentralizing collaboration*. For each theme, we will discuss participants' main challenges and potential design opportunities for social media in promoting cultural heritage for cultural diversity. Throughout this section, pseudonyms are used to refer to participants.

subsubsection Implication 1: Redefining the expert Firstly, our findings suggest to consider local audiences as experts and, therefore, as an important marketing channel. This adds to Kidd's argument in the relevance of promoting the 'face' of an institution; local visitors or local residents should play a more significant role in creating an institution's face in promoting cultural heritage [73].

This is supported with the following arguments. Both cultural heritage professionals and general audience interviewees shared challenges (i.e., related to 23 and 39 transcription items, respectively) with respect to finding content and events such as due to the "Google's filter bubble" and algorithms in general. Participants feel biased in discovering cultural related content as well as a sense of unfulfillment in finding content at all. General audience interviewees, for example, expressed the feeling of being overwhelmed or overloaded by the events, activities and content promoted on social media: almost every cultural institute, if not all, are reaching their audiences using similar standard means such as Facebook, Twitter, and Instagram. For a professional like Fabio who is a journalist, it is difficult for a potential target audience in Germany to find his content as most of his audiences are from Greece. There seem to be even a bigger challenge for discovering intangible heritage related content and events, such as for folklore and traditional dances.

In response to these challenges, general audience interviewees rely strongly on information from their immediate friends or from locals nearby during their cultural visits as they have low confidence and trust in social media content for the reasons described above (i.e., 18 transcription items were related to trust, and 10 transcription items were related to discovering content through word of mouth through peers or local people). Discovery usually takes place by direct messaging, face to face, or when friends take one another on a cultural visit. Interviewees expressed their preference in approaching locals or connections as they hold immediate and trustful expertise of information beyond that is publicly promoted.

### 5.7.6 Workshop and Co-design tools

In this stage, a workshop was organised in two phases to gather user generated content with people familiar with the artefacts, hence who live or work nearby. In Phase 1, participants were first given the concept of Pluggy and visited the case study site. They were then asked the following, “What does this artefact/building remind you of?”, “What influences do you see?”, and “Can you identify any specific artistic/architectural features?” and answered these questions by sharing an image or images with comments on Instagram. If they could not share it on Instagram for any reason, a researcher recorded it in a word document. Quotes from the comments gathered in this workshop were used for the curated narrative in Phase 2. A second task was given to co-create and draw a curatorial interface tool based on their experience of sharing content in social media.

#### preliminary results and analysis

The Participants all agreed that they would love to share mostly pictures and photos on this platform. Since for example in a city like London the spoken languages are many, it can be great if the tool is as much easy to read as possible. In addition the the written text can distract and dismiss the people from the web pages usually. They’d prefer to just interact with images at the first glance, and later share some text or few words.

The participants would like, after seeing the other users’ contents, comments and personal thoughts pool about the places where the photos have been taken. They expressed that they would benefit some honest reviews from other users prior to select the locations to visit. They also said that is important to keep the comments section visually short at first, like a small twitter feed, and then if the users are interested they can investigate more comments by themselves. The participants suggested that it can be useful to gather the best comments once a month, every two weeks, related to some location: this can be transformed into a useful “travel suggestions/tips” section curated by the users

The design later design process, therefore, actively sought to engage with the ‘situated’ nature of these suggested assets and to allow for ‘empathy’ to be developed be-tween designers and users.

A huge amount of content digital cultural content is available nowadays on the web, but to get a good perception of the usefulness of mobile applications in the outdoor context , this workshop validated that vital investigation should focus on the narratives, interactions, and conversations that are part of people’s everyday encounters with this environment. The findings from the co-design workshop indicated that it’s vital to actively seek to engage with the situated nature of these encounters [47] and to create the chance to develop empathy between designers and users. Summing up, the goal that emerged was not to implement a

guided tour, by simply supporting the historical urban t narrative of the experience. Rather, the participants expressed the will to engage with the cultural site.

### 5.7.7 Preliminary results and Journey map

2

#### extending the experience space

The findings shows an opportunity in blending discovery and experience e.g., what happens at home or in a hotel room could transition to what happens on site. Dialogue in social media often come from a small number of contributors (or active community members) (Alexander et al., as described by Kidd, 2011 [73] ). To encourage and enable more genuine participation, dialogue and inclusive spaces, content could be made more dynamic and interesting for a broader audience who are navigating in a broader space. Kidd [73] discussed two examples of good practice for inclusive spaces, highlighting reflexivity and the need to accommodate different audiences. The Powerhouse Museum in Sydney who has relaxed its policy, recognising that taking photographs is an important part of the experience for visitors. The Australian Museum who started making a distinction between the needs of different kinds of visitors by hosting separate blogs.

In further promoting inclusive spaces beyond museum spaces, our findings shows an opportunity in blending the discovery and experience.

Interviewees usually plan high level activities and allow space for discoveries on site and in the moment. They use cues within their environment (e.g., large colourful objects or crowds) to lead their attention and make decisions in the moment. Although, professional interviewee view this space for discovery positively in supporting serendipity, it might affect visitors motivations in, e.g., downloading applications for better engagements with objects upon entry. There are challenges in having visitors use their own phones. They may need to create space on their phone, not have fast internet, or there may not be enough time to download and understand the functionalities of an application. According to Alfred, visitors don't want to download something for a visit of a couple of hours and then never use it again. Consequently, visitors may just come and see beautiful objects with limited engagement. Hence, the museum or cultural space is currently not perceived as part of their everyday space.

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<sup>2</sup>part of this section is Section under revision from IC London for future publication

## 5.8 Design and Development

This step of the project is focused on improving the features of the Pluggy's App, by designing and testing the single features, such as geolocation and audio narratives, prior to develop fully the prototype. In fact, in the design development, first the functionalities are tested, and later in a last step the mobile system is implemented and coded. In this phase 2 designers and 1 engineer with the help of 2 voice actors, recorded the audio excerpts and crafted the beginning "physical" interface (the cube) and the web interface to later access the narratives.

### 5.8.1 Platform design and technical challenges

The previous design exploration was part of a situated application research done in a traditional museums and indoor context. Being outdoors creates an assortment of specific challenges and gives plenty of novel possibilities. However, the visit is a full-body experience, and outdoors is even more complicated than inside a museum: spaces to cover are larger than when moving from exhibit to exhibit and from room to room, and there might be a sense of expectation before reaching the point of interest.

The engagement in a museum tends to be dictated by an extended observation, in an outdoor setting where multiple senses are stimulated: there is still the physical experience of being there, but the sight and the sound of the surroundings of a closed environment could reduce the perception of freedom of learning [] and create a rejection toward the content and distress. In this sense, the outdoor setting places the visitor in connection with the heritage indirectly, and enables an emotional level of engagement, rather than at a pure informative level [34, 29]. The technology used for this project uses a binaural audio 3D experience, supported by the open-source standard C++ library 3DTI Toolkit developed at Imperial College []. Binaural literally means involving both ears in the act of listening. Binaural hearing is related to the ability of the auditory system to perceive the sound at the two ears and combine the data from different sources and perceive sound as originating from a 3D space. The binaural audio creates literally a soundscape that allows the user to feel embedded in real environment by simulating distances and directions with the sound sources. This technology is still on testing for spatialisation tools, and it's usually used for helping audio impaired people in recovering from hearing loss. But in this case we wanted to use it for helping to better contextualize a cultural content in a more immersive way.

### 5.8.2 Creating a narrative audio experience

The core aim of the planned audio experience was the seamless interaction: the audio narratives are triggered by the user on his/her own will, and they are

enjoyable without forcefully reading a written text. As we wanted to bring the possibility to roam around the building without checking the phone if it was not necessary, in order to don't steal the focus of attention from the artifacts.

The key feature was that visitors could interact with the system by just walking the site, since the narrative were geolocated. We wanted to craft a form of seamless embodiment of the heritage, making use only of the proximity of the visitor, rather than some form of continuous expressive interaction that would meddle with the natural behaviour and group-formation in an urban heritage site [27, 93]. During the situated experience, interaction with devices was intentionally reduced to the minimal action of wearing a pair of earphones and listening to the audio excerpts. The crafting of the narration was based on the contextualisation of the Victorian age. For the curated content 2 main characters were speaking in the background, such as Prince Albert and Queen Victoria. Their narration brought the visitor to discover insights about the history behind the construction of the whole area and the motivations behind the establishment of the Royal Albert Hall and the Royal College of Music, (see Appendix A).

The design was intended at conceiving an evocative experience strictly connected with the sense of being in place. The value of narrative to the appreciation of the heritage should not be undervalued since a great part of the engagement is related to the ability to contextualize the cultural content.

## 5.9 Situated applications and evaluation

This situated application has been conducted to explore potential design opportunities for social media and technology and to identify issues and challenges in involving people participatory action in Cultural Heritage. This application was aimed at supporting the results from the empathy interview with a case study. In this experimentation the narrative purpose was to broaden the impact of artefacts in a built environment using curator vs. user generated audio narratives. The aim was also to explore how user-generated content (UGC) contributes to visitor's engagement within an 'everyday life' context, understanding the challenges and the opportunities that may emerge.

### 5.9.1 Co-design, UX prototype and functionalities

In order to support findings from the interview study, a case study was conducted around built environment of Kensington Gore, specifically on its urban heritage. As introduced before in Sec 5.1.1, heritage has a compelling role in postmodern tourism, and specifically toward the built heritage. Architectural collections are popular tourist attractions, which according to Nuryanti can be defined as *"the heart of cultural tourism"* [111]. The relationship between tourism

and heritage, however, has frictions that usually emerges due to the juxtaposition between tradition and modernity, globally known and locally known. Built heritage can be used as an artefact to promote ethics, history, or industry, but can also be experienced by visitors through a narrow understanding of time and place. Architecture can be an immersive space into the history of the city, but the general lack of knowledge toward architecture prevents people to engage with the built environment. An intriguing perspective is that architecture could act as a common ground that is usually shared by a mixed public, including tourists, employees, and locals, while limited information is available to contextualize the artefacts. The square at Kensington Gore contains such built heritage allowing views of historical buildings and monuments. The site allows an exploration into broadening the narrative experience through public contribution, which could open up interpretations and links to other urban landscapes (i.e., architectural artifacts are often related to artefacts displayed in museums or other buildings in other cities). The architecture or artefacts of interest for this case study are the Royal Albert Hall, the Prince Albert Sculpture (The Great Exhibition Memorial), the Royal College of Music Building, the Albert Court, and the Beit Quadrangle. See Fig. 5.9 and Fig. for some views of the site.

## Participants

A total of 28 participants were recruited through the university network. Considering our findings in the importance of local audiences in sharing heritage information, participants either work or study at the University. Additionally, previous work suggests awareness toward local heritage should be promoted at first among locals in their living or working environment [141][112].

## The audio narrative and User Generated content

For each artefact of interest shown in the Fig. 5.10 (i.e., the Royal Albert Hall, the Prince Albert Sculpture (The Great Exhibition Memorial), the Royal College of Music Building, the Albert Court, and the Beit Quadrangle), two types of audio narratives were created; a traditional curator's narrative and a user-generated narrative. The curators narrative was created in partnership with a Architectural Historian, specifically trained in London's Victorian urban development. See Appendix A. The user-generated narrative was derived from participants and as part of a co-design workshop where participants shared their thoughts about the site they would publish on Instagram (details of the workshop will not be discussed here further as it is not relevant to the purpose of this paper). See Appendix A. A total of 15 participants had access only to the curator narrative, whereas 13 participants had access to both the curator and

user-generated narratives.

The narratives were accessible through QR codes printed and attached to a laser cut cube (See Fig. 5.11). Each QR code was linked with the image of an artefact or building. On one side of the cube, open questions were presented to trigger participants to comment on the narratives: “*What does this building remind you of?*”, and “*What influences do you see?*”. Participants were invited to add their comments or pictures on Instagram using a specific hashtag or in Medium using specific tags. Comments were used to create the user-generated narrative.

At the start of the study, participants were given a short introduction to the design probe i.e., cube, and how to access the narratives. They were further not given specific instructions other than to freely select the audio narratives in the order they want to listen. They were allowed to walk anywhere within the site. Participants were either given a smartphone and earphones or they used their own devices to access the audio narratives. The narratives were available in text as well as in binaural audio.

During the study, participants were shadowed and observed. The same map of the test site used in the Sect. 5.5 was used in this situation to annotate navigation, touch points, and behavioral insights. Participants decided when they finished by reporting back to a researcher, since on purpose was not give any time constraint to each session.

At the end of study, participants were invited to answer the MEC spatial presence questionnaire to measure engagement and to collect general participant information. The MEC-SPQ [158] was designed for immediate assignment after media exposure and consists of questions related to *Attention Allocation* (i.e., to understand which media was more effective in communicating: written text, images, or audio), *Spatial Situation Model* (i.e., to understand the users’ ability to describe to which extent it was possible to link the content to their physical surroundings), *Self-Location* (i.e., to understand how grounded the user felt to the mixed-media environment), *Possible Actions* (i.e., to understand to what extend the user feel like they can act on what they see or hear), *Higher Cognitive Involvement* (i.e., to understand how the content was activating the thinking of the user), *Suspension of Disbelief* (i.e., to understand if the user was able to spot errors in the content or was biased toward the user generated content), and *Domain Specific Interest* (i.e., to understand how much the user is interested in the topics related to the study. The participants who had the option to listen to both the curator narrative and the user-curated narratives were asked to comment and explain their preference.



## 5.9.2 Findings and consideration from the data collection

For the analysis, we looked at participants decisions and comments with regard to their preferences for curator vs. user-generated content (this was only possible for 13 participants) and how this may relate to their demographic background and previous experience on the respective heritage site. Descriptive statistics were used to analyze the spatial presence questionnaire scores comparing participants who had access to curator only vs. curator and user-generated content. This gave some insights in engagement differences. We further discuss the scope to which participants contributed to user generated content and the challenges with these.

### Results

We explored participants' choices, preference and engagement with the curator vs. user generated narrative to build further on the main challenges for social media in promoting cultural heritage for cultural diversity around the three design opportunities presented in the first part of this research: *redefining the expert*, *extending the experience space*, and *decentralizing collaboration*.

MEC Spatial Presence item category	Curator narrative	User-generated narrative
Attention allocation	3.77	3.83
Spatial Situation Model	3.54	3.60
Spatial Presence: Self Location	3.87	3.32
Spatial Presence: Possible Actions	3.79	3.00
Higher Cognitive Involvement	4.24	3.56
Suspension of Disbelief**	2.74	2.74
Domain Specific Interest	3.77	3.23

Table 5.3: Average scores for the MEC Spatial Presence Questionnaire for each item category.

### Support user engagement in transition spaces

The MEC questionnaire results did not highlight a big difference in engagement between curator vs. user generated narratives. As shown in table 5.3, scores were slightly higher for self-locations, possible actions, higher cognitive involvement and domain specific interest when listening to the curator narrative. Overall, scores were just above average for both narratives, which could indicate that participants were not immersed as much as we hoped for. We believe the challenge may lie in the nature of the context: its part of participants' 'everyday', 'work' and 'study'. How can local audiences transition within the same context but between different mindsets e.g., of work vs. non work. The question is how can design help in transitions within the same space? How can these spaces call



for engagement?

### 5.9.3 Co-design workshop for the 3D soundscape tools

International Engineering and Product Design Education conference a co-design workshop has been hosted to co-design and evaluate the features of the beta version of the Apps prototype. The workshop explored a part of the PLUGGY social platform and ‘pluggable’ for 3D sound and augmented reality. The main purpose of the 3D audio workshop was to gather user feedback and insights from use of the prototype Pluggy Soundscape app on Kensington Gore and on the temporary exhibition at the Natural History Museum in London, Life in the dark. The workshop introduction provided an overview of the App and its intended use by professional and amateur co-creators of cultural heritage information. At the same time, in this occasion, the audio experience was meant to be enjoyed online, and not onsite, so the navigation happened on tablets and Pcs available at the venue. As showed in Fig. 5.14 and Fig. 5.15 the Plugsonic app provided the binaural 3D audibles for the participants, that were 20 divided in 4 groups of 5 people each.

Workshop participants worked in teams as curators to develop ideas for 3D soundscapes for visitors to either the Albert Memorial or the NHM Life in the Dark exhibition. At the end of the session, each group

The participant

data from workshop with Stephen pics - word In association with EPDE 18 conference

## 5.10 Reflections for further development

### Collaboration requires a universal language

During the case study, not many participants contributed to answering the questions presented on the cube. Participants who did share something, which was also used for the user-curated narrative, shared mostly pictures and photos with brief captions on Instagram, since it was the quickest way to share content. It was also considered the most effective way because of possible language barriers (e.g., images are easier to approach a wider range of audience than a written text). Hence, a universal language should be supported to empower a general and international audience in curating cultural heritage content. For example, a universal language could be visual or auditory content that expresses an emotion or can trigger a feeling associated with an experience. Tools to allow people to curate content should be made easier to express this universal language, contribute and share.

### 5.10.1 Approach the tangible with the intangible

In order to consider local audiences as experts and, therefore, providing user-curated content potentially from locals, the cultural background and knowledge level of content consumers should be taken into consideration. User-generated content may only be effective to those with familiarity of the context whether this is due to a shared cultural background or having advance knowledge and experience on the heritage site. The type of content could be tailored for different cultural backgrounds and knowledge levels depending on the audience, rather than the cultural topic itself. It could be interesting to think about layering the information related to the heritage site, since different level of prior knowledge could impact on the perception and the usefulness of the information. The MEC questionnaire, however, showed minor differences between the two type of narrative which may be showing challenges in transitioning people between mindsets within the same 'everyday' space. Finally, findings shows that a universal language should be supported to empower a general and international audience in curating content and to allow for decentralized collaboration.

## Shadowing and Observation Template

**Participant no:**

Time start:

Time end:

Perceived time:

Stop points (time, notes),  
annotate also in figure:

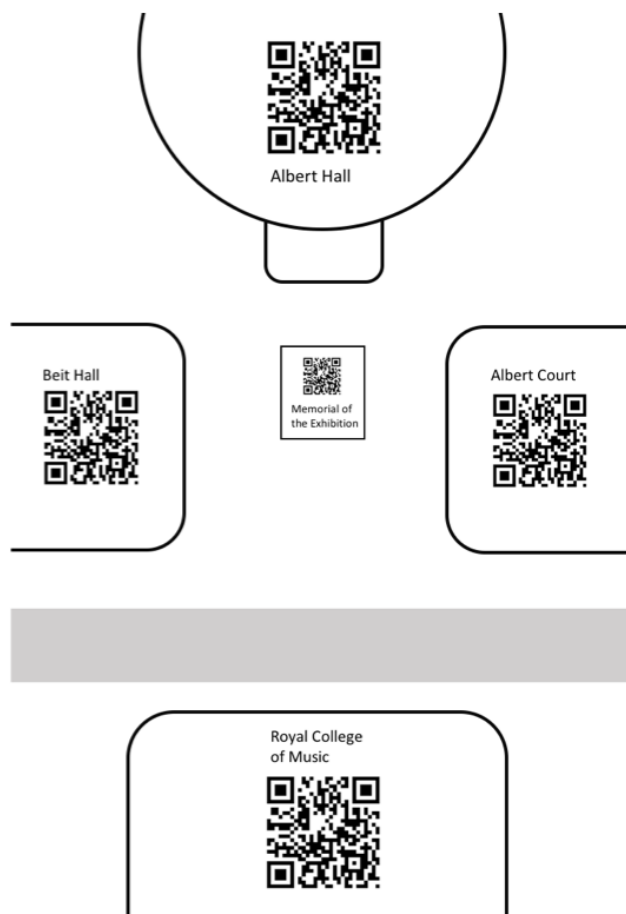
1.

2.

3.

4.

5.



Comments:

Figure 5.5: The observation template used to track the visitors behaviour during both the preliminary ethnographic stage and later in the situated application.

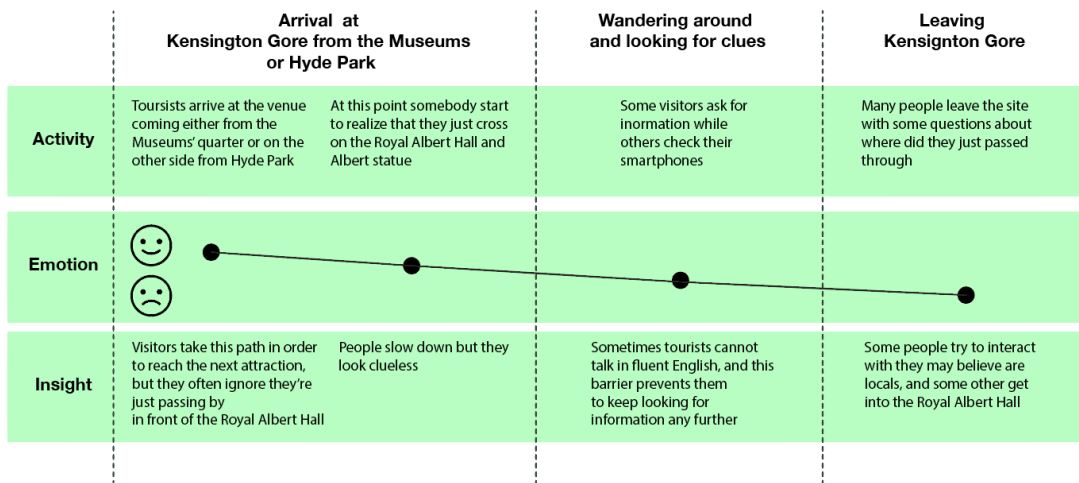


Figure 5.6: The User Journey emerged from the discovery stage of the design methodology. It's noticeable how the user experience before the intervention is not that meaningful and rather disruptive.



Figure 5.7: A picture taken during the workshop co-design session.



Figure 5.8: View of the site with the Royal College of Music Building and the Albert Court in the background.



Figure 5.9: View of the site with the Prince Albert sculpture and Albert Hall in the background.



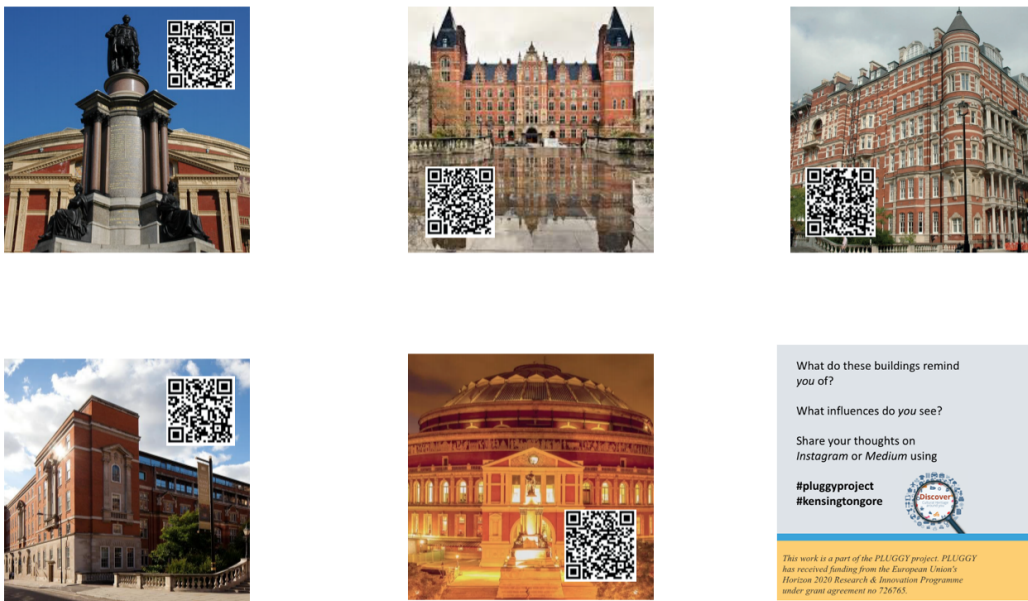


Figure 5.10: Each artefact of interest was depicted on a face of the cube given to the participants. For every building there was a QR from which was possible to access the narrative content by smartphone.



Figure 5.11: Each participant used a cube with 5 images and QR codes on each side to access the text and audio information for each respective artefact. On one side of the cube questions were shown to trigger visitors thoughts around the artefacts.





Figure 5.12: A picture taken during the workshop session at the International Engineering and Product Design Education conference 2018.

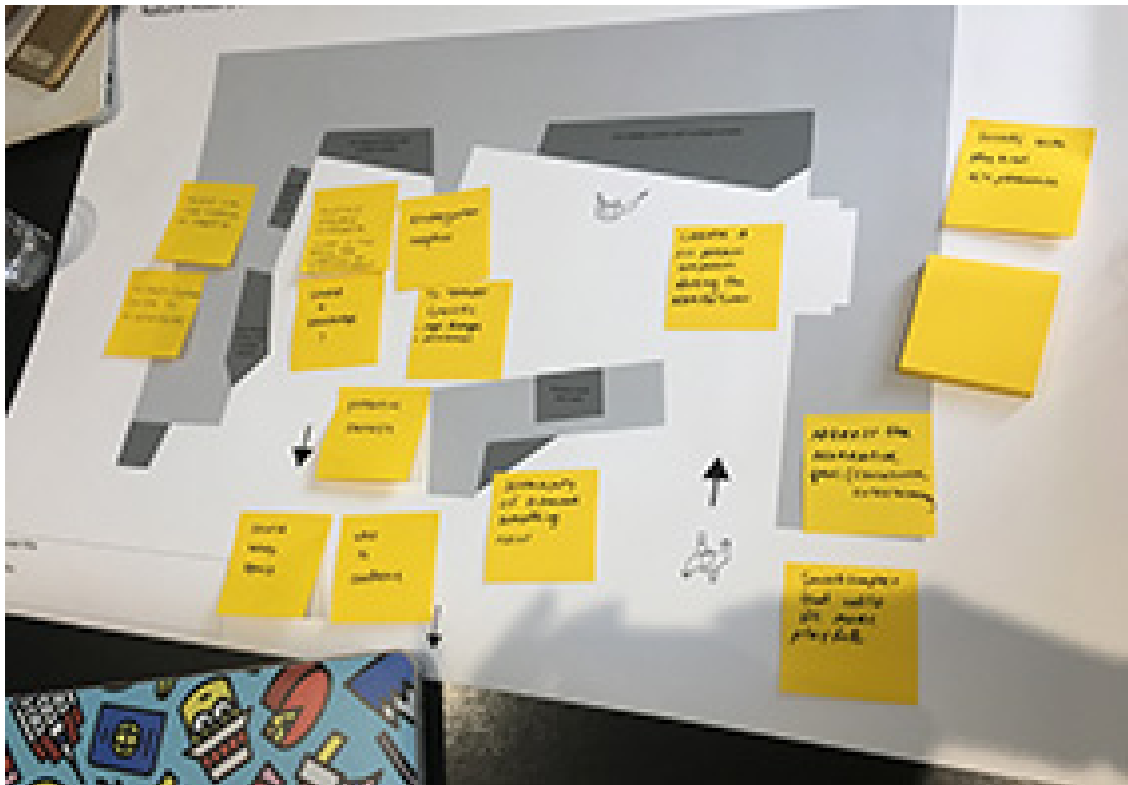


Figure 5.13: A picture taken during the workshop session at the International Engineering and Product Design Education conference 2018.

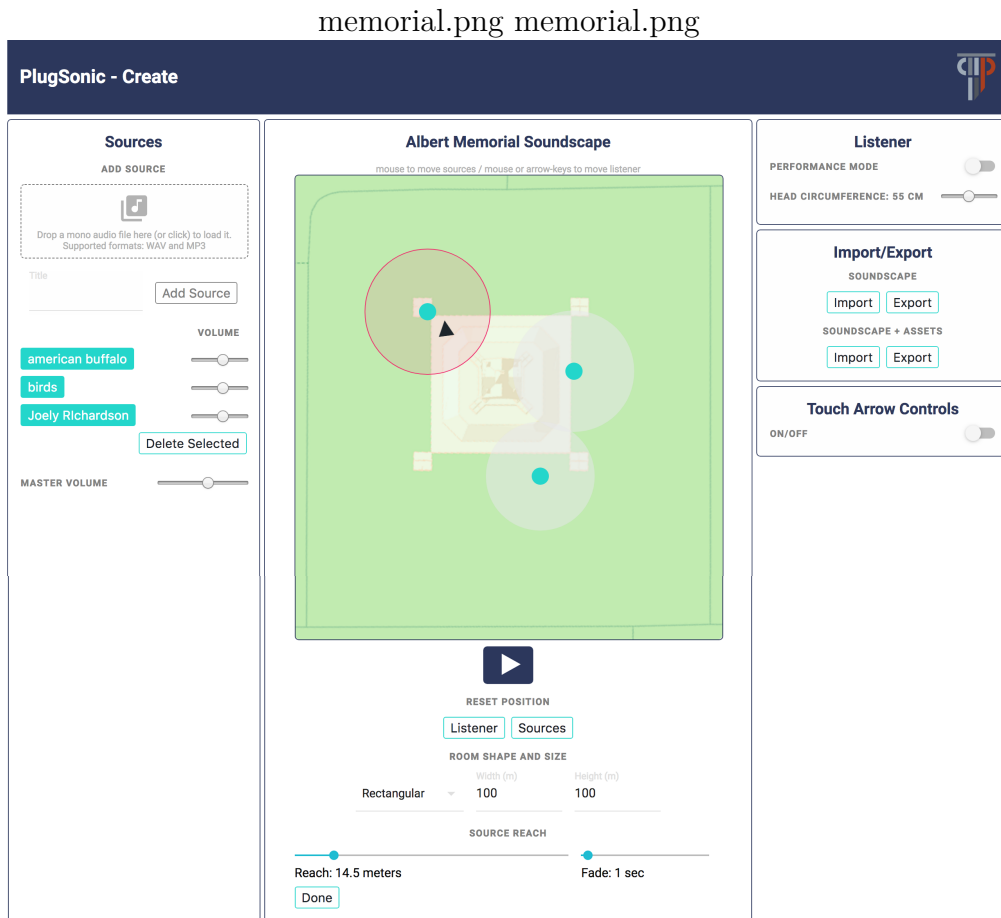


Figure 5.14: The figure shows the web interface for engaging with the 3D audio tools. In this case Kensington Gore is depicted with the touch points on where the audio narrative is audible

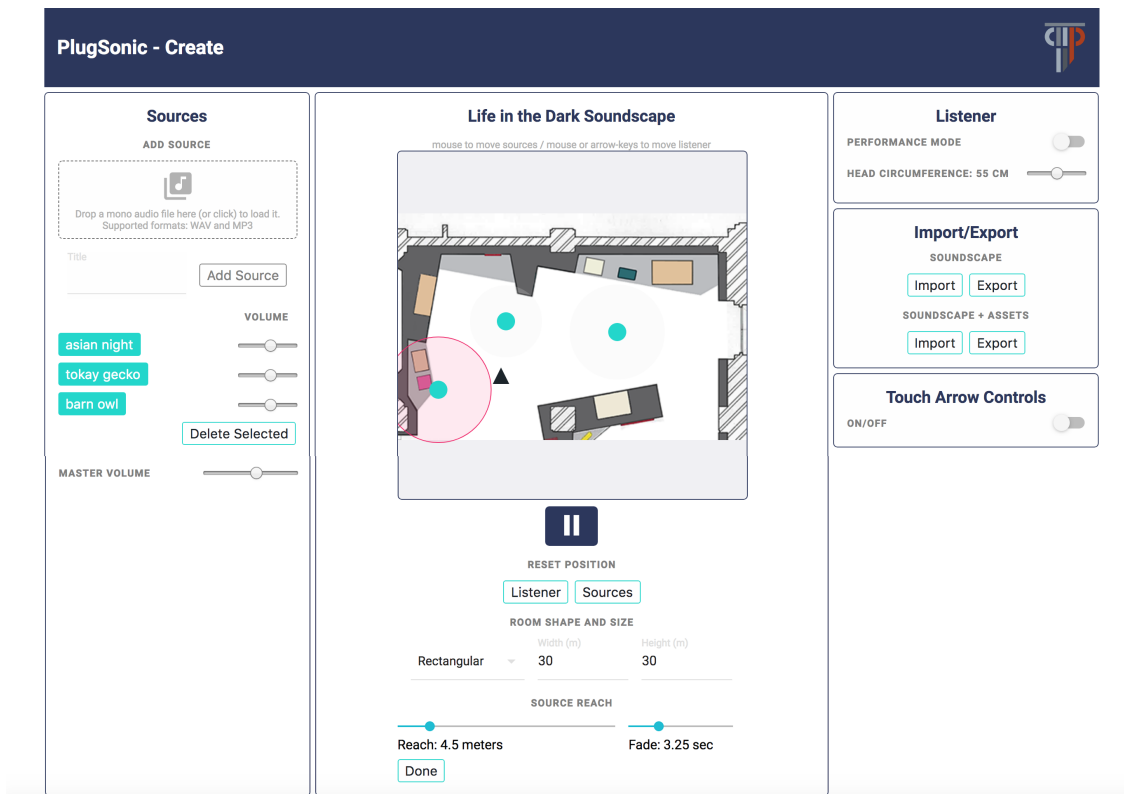


Figure 5.15: The figure shows the web interface for engaging with the 3D audio tools. In this image is depicted the venue of the National History Museum that hosted the temporary exhibition "Life in the Dark"



# Reflections and discussion on design opportunities

<sup>1</sup>

The reflection derived from the design of the situated experiences in addition to the contributions to the RtD approach was a fundamental aspect of this research. The shareable knowledge derived contributed to reply at the research questions posed at the beginning of this thesis. The results of the distillation of the literature review and the design action gave birth to the actionable insights that will follow in this chapter. These insights are both effective for future design research in this field, but also to define more in detail which kind of choices is advisable to make in terms of design methodological steps.

## 6.1 Considerations

At the beginning of this thesis, three main research questions emerged, both from the analysis of the cultural heritage scenario, and from the literature review. The questions namely are:

- Can we raise awareness toward cultural heritage?
- Is it possible to improve visitors engagement?
- Is it possible to engage a vast section of visitors with low impact technology?

Well, the answer is yes, to all of them, but with some considerations. First of all, raising awareness toward Cultural is possible by creating an inclusive environment. Inclusivity is one of the key factor that eases the access to culture and therefore promotes and creates the space for awareness to happen. In the experimentation in Kensington Gore, regarding the audible and written narratives, exceptions in terms of preferences have been declared in favour of written text, especially by people who speak English as a second language. In

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<sup>1</sup>parts of this entire chapter are under revision from IC London for future publication

fact, these users also tended to roam around the surroundings less, and pay more attention to the script willingly, since, according to one of the participant *"his will to read more content about the surroundings has overcome the trigger to roam around the statue"*. But, according to the same participant *"after getting to know more about the topic, he felt like exploring around more carelessly"*. Also, the content itself could be rephrased in a more readable way, as an example, 2 participants from far East Asia and one from North America demanded for a more specific translation of a Latin inscription under the monument. All the three participants were from countries who don't study Latin as a subject in high school. This means that in order to promote awareness, inclusivity must be taken into account. Inclusivity means also the ability to personalise your experience, such in the case of the London based application. Since in this experience, users were able to select which kind of medium was more enjoyable for them, between written text and audio, and to be in charge of your decision means also a resulted higher engagement.

In replying to the second research question, it's truly possible to improve visitors engagement. In doing so, first it's essential to design the solutions together with the users in a co-design approach, but also, it's important to give freedom of choice to the users. As stated in the the situated experience, whenever the users were given the freedom to decide the amount of time to spend inside the museum, or the way they could access and roam into a urban environment, their engagement immediately spiked. In addition, engagement is determined by personal contribution and commitment, and for this reason, in Sec.5 was tested a new way to let the user generate their own cultural content, in forms of personal contributions that would primarily positively engage them. So to define opportunities to raise engagement it's important to "give not too much freedom", otherwise we can incur in the opposite effect of the tyranny of choice [132], but also, let the users be motivated in exploring more themselves the CH. Hence the design interventions it's exactly in this spot: it calibrates how many opportunities of choice could be available, by also letting a considerable freedom of choice and engagement.

Lastly, in reply to the last question, it is definitely possible to engage visitors with low-cost technology solutions. First, the monetary aspect of this solution could enhance of course the adoption rate from public and private cultural institutions. When the adoption rate rises, then the window of opportunity for design research is opening up. Secondly, since the cost are low, it's possible to adopt a rapid prototyping iterative approach, that brings good pieces of research work during the development of the product. This is important not just on a financial level, but on a more human factor related one. Since if the design process could be integrate part of the product development, it's possible to envision from the very start variables such as inclusivity, awarens and usability.

## 6.2 Design guidelines and reflections

In this section, consideration that spurred after the application will be pointed out after the situated design experimentations. These guidelines, are the results of the reflection that the design contributions arised during the iterative process.

### 6.2.1 Culture as a tool - innovation for enhanced accessibility with ICT

Innovation and change are populating the agenda of commercial, not-for-profit, government and local public organizations in cultural heritage [36].

In recent times, corporations started to notice that the prevailing business models based on affluence of natural resources are no longer sustainable and necessary system change is required. As stated in Ch. 5.7.1 it has been claimed that heritage that is connected to our everyday life, is likely to be one of the prerequisite for true sustainability. Innovation is considered to be essential for our future, and in this thesis is discussed how cultural heritage, a field that is not primarily known for introducing substantial technical innovation, could really benefit from ICT. The adoption of new technologies, specifically in the cultural heritage enviroment, could generate revenue and activities that could possibly "glocalize" and bring more highlight to new aspects of the society. Connecting with heritage in the everyday has been oe of the pivotal point of the situated application in Kensigton Gore. Since a deeper understanding of the everyday and the surrounding oculd bring new perspective, and why not, new technological opportunities in the daily life.

*There is huge hidden value available in cultural institutions. A lot needs to be learned about how to surface and leverage it for the 21st century in a meaningful way [36]*

Investigating a promising field often demands inevitable innovation in methods and techniques. With the rising use of mobile technology, people find themselves carrying around these devices constantly and they do interact with technology embedded in the environment in a seamless way. Existing field research methods have problems at following and observing this new and flexible use of mobile technology. And therefore, agile and rapid prototyping are becoming the norm in the User Experience environment. Quantitative and Qualitative methods have been extensively used in UX since the last two decades, but in this research they were paired with the Research through Design approach for a more feasible and insightful situated model of action. By to not scaling up, the in situ nature of this applications draws new qualities of human life that need to be addressed in new ways. Helping understanding when is the case to use a technological solution is a priority for design, that doesn't just addresses to the innovation of new



technologies and methods, but above all on the overall quality of human life.

situating, iterating, infrastructuring

low key, low cost prototype can help in save money and guarantee

## 6.2.2 Empathy and iterative processes

The iterative process that works alongside the prototyping of new concept is the key to guarantee innovation on a fast pace, but with an eye on users needs. During the iterative process, the user research took the same space and time as the product development, since the discovery of the user needs and latter requirement is not anymore something that can be considered ancillary. The whole iterative process in this research spanned from the discovery stage, to the design and development and the situated application. All of these steps have been taken in parallel and the main issue was to create and evaluate feature that would have been feasible for the users. Design process cannot start without a deep understanding of the people you are designing for, and in this sense, the discovery stage in the the situated experiences helped lots in cut out or integrate specific functionalities. As an example in the Egyptian museum case study, at the beginning was envisioned to insert video content in the App, but later on, this decision dropped in favour of a more focused crowd on the artefacts rather than the smartphone. However, to gain those hints and tricks, it is crucial for designers to empathize with the people the product is meant since thoughts, motivations, and emotions are the pillars or the decision we make every day. The good sides of this enhanced methodology is that to empathize with users luckily there is a wide range of methods and, in addition prototyping is become relatively cheap.

As an example in the London case study, the prototype was made out of cardboard and plywood , but nevertheless was optimal in test the functionalities we wanted to implement in Pluggy.

The cost-efficient system to improve designs before the development, bring the the design research ahead on a top place in the product development chain. Every time the design research has not a place to be in the developing process, is striking how the difference between what users said they would do and what they actually do is large and expensive to overcome. So giving the design a place from the start, and possibly in a strategic asset in the production chain could also benefit the costs. It can be especially valuable when a team is faces several ideas and is uncertain of which one to pursue. Developing a prototype of each feature and then collecting user feedback can guarantee that the best ideas are taken forward and those which do not give as much advantage are dropped with no expense in their development.

### 6.2.3 Designing ubiquitous cultural spaces

The ongoing discussion about personal mobile technologies shed light on several details regarding uses and handset capabilities, differing from those participants who celebrated the values of Bluetooth to those who had never sent a text message (although both extremes were in the minority). Wright and McCarthy [164] stated that the experience-centred methods may fall in the hazard of that *“empathy will be regarded as something vague, mysterious, unwarrantable, undocumentable and unusable”*.

The study conducted in this thesis intended to address this issue by building deeper connections with participants, and evaluating design prototypes through additional participatory design exercises [97]. And this will carried on the goal of seeking new cultural context, indoors with the museum, and outdoors, with the London urban environment. These different contextualizations brought on the plate terms of discussion toward the the creation of spaces to enjoy heritage. The mentioned spaces could be real or virtual but, the most important thing is to engage the users by creating evocative experiences.

In all these steps, a keen awareness of the design sensitivities has driven each decision. In conclusion, the empathic design approach adopted in the thesis investigations, achieved to challenge designers, heritage professionals, developers and participants involved in the co-design workshops to consider mobile interpretation not only as a vehicle for heritage information. It should indeed be considered an on-site opportunity for active engagement and dialogue with both one’s companions, the heritage environment and its surroundings.

## 6.3 Limitations

One of the limits that arise during this research is, that despite the body of literature depicted in Chapter 2, there’s a substantial lack of defined and systematic approach toward Human-computer interaction for cultural heritage. Nevertheless, in addition to the literature review carried out in this research, the investigation could have taken another path. Nowadays, many researchers in the design field and are touching new areas of expertise such as museology, therefore there still not enough knowledge about challenges and additions that other ongoing studies are encountering in the cultural heritage scenario. Especially because many pieces of research are commissioned to private companies that are rarely interested in sharing the results in the broad light for commercial reasons. Hence, ethnographic studies directed at bringing out these emerging practices could contribute to the knowledge on Human-computer Interaction. Hence, ethnographic studies directed at bringing out these emerging practices could integrate the literature review on Human-computer Interaction. But, a more sharing an open source approach could actually do wonders in increasing

knowledge in this sense. Conferences and publications, and even case studies are absolutely important; however, creating a network of discussion with professionals in UX design for commercial purposes could solve many still open questions about design methods. In fact, as introduced in Chpt.2, several social crises in cultural heritage, made possible a huge paradigm shift for the public appearance of conservation, and museology. In fact, if cultural heritage wouldn't open up to the change, nowadays would be hard to enjoy leisure experience in museum, for something that has always been relegated to just the educational and austere side of the knowledge. But as Vinson [152] said, *In Europe, with public finances in decline, new ways of maintaining such cultural resources need to be developed as they offer social and economic benefits over the medium and long term. The danger of losing these assets in Western Europe should be made visible to business.* This means that whenever there is a crisis, there's also a chance of opportunity to grow. In this sense is desirable to put more into a constructive dialogue the commercial side of Design and UX research, with the Academia. Taking into account the methodology, a limitation is a deficit use of certain quantitative and qualitative methodologies due to the lack of funding in a area such as the cultural heritage. This could be challenging, but there's hope since new low-cost technologies and low-fidelity prototyping are appearing on the research scene, giving more freedom of intervention to the Design practices. An other issue concerning the methodology is the difficulty of gathering participants to the case studies in the design field. This is very true due to lack of efficient communication that prevents designer to reach the potential users for their product under development. This obstacle could be trespassed however, by using the new media and giving more freedom of choice to the users. This was the case of the choice of giving to the users in the Pluggy project the possibility to generate their own cultural linked content. Since by giving a direct task to the users is actually possible to make them more proactive and aware.

## 6.4 Future works

The main lesson learned from the experiences that supported this research is that awareness is pivotal to create a positive environment to foster dissemination and conservation for cultural heritage. However, the key to promote awareness is through inclusivity. Without proper access to the cultural content, people are unable to engage in a meaningful experience with Cultural Heritage. The work presented here could be of great value to help identify design spaces to explore the use and design of social media and social technology aiming at supporting participatory action. Knowing this, very much indeed, further work is necessary to explore different case studies and media type content. To pursue a better awareness and inclusivity toward cultural heritage, design best practices should be integrated

from the start of the product development, and in a more systematic way. But in doing so, it's necessary to educate also professionals in this field, otherwise the adoption of design methods won't be consistent.

But this integration, needs itself a strategic plan to let the product development fully integrate the design practices, since it's vital to understand where the design thinking could make the difference and let the users express their own needs freely. A tool that could be implemented and has stated to been applied in this research is the use of social media. We still know very little about the impact that user generated content could make on users' engagement, thus it's a viable way to investigate new design chances.

In regard of the design guidelines and reflections, further investigation will certainly benefit from deeper insights. Although further case studies could shed light on gap in the knowledge, and a collection of new use-cases with their own research questions could be investigated and developed by including the design guidelines from the start.

On top of the theoretical knowledge, the design research could be applied to the development of the prototype of the interfaces developed during this study. As an example, the Pluggy project which the second design exploration is part of, will carry on the next steps and reach new milestones with the supervision of the Dyson school of design at Imperial College London. New features will be tested in the beta version since the alpha and the low-fidelity prototypes were just the beginning. In the end, it is desirable to benefit from a more collaborative environment, to tackle issues that are dear to design practice. The continuity of the design research must be carried on but in an increasing dept of knowledge.



## Appendix 1

### Appendix A

**Royal Albert Hall:** *“It’s beautiful isn’t it? The Royal Albert Hall. It seems like only yesterday when I was talking to Henry Cole, chairman of the royal society of arts, about my dream to build a permanent exhibition hall. A sort of “follow up” of the Great Exhibition of 1851. Oh, by the way, my name is Albert. . . and I was the Prince of Saxe-Coburg and Gotha. I had a beautiful wife, Victoria, queen of England. If it wasn’t for her and Henry, the royal albert hall wouldn’t exist. The Hall was opened on 29 March 1871 by Queen Victoria, renamed in my memory to the Royal Albert Hall of Arts and Sciences. When Victoria opened the Hall, she was so overcome by emotion that the Prince of Wales had to speak in her place. . . She was one of the most beautiful women on this world. Unfortunately, I wasn’t there at the inauguration. But they told me that as she laid the foundation stone, she said “It is my wish that this hall should bear his name to whom it will have owed its existence and be called The Royal Albert Hall of Arts and Sciences”. But the Royal Albert Hall is part of my dream resulted in the construction of Albertopolis. The area is here in South Kensington and contains several structures dedicated to the arts and sciences. For example, I’m now facing the Imperial College London. Ah. the Imperial College. . . the name me and Victoria chose for the building was Imperial Institute! Unfortunately, I didn’t have time to see the opening of this building either. . . due to my early death. The college was one of the first in Britain to teach by experiments rather than just by lectures.”*

**Royal College of Music:** *“Within sight of the Royal Albert Hall are two buildings dedicated to music. The first one, with your back to the Hall, is the Royal College of Music. It originated from my proposals for a national music training scheme for young people. Founded in 1882, it is now part of the University of London. The Royal College of Music is one of the world’s leading conservatoires. It provides specialised musical education and professional training at the highest level for performers, conductors and composers. Some of the world’s best classical musicians have studied here. Listen carefully and you may be able to hear students playing inside.”*

**Albert Court:** *“The Albert Court is one of the first historical Flat housing facilities in the UK. This mansion block was originally conceived by the freeholders and commissioners, as the first stage of a larger private development. Building began in 1890 to the designs of Frederick Hemings but, following the collapse of the Liberator Building Society in 1892 and the death of Hemings in 1894, the building had only reached the 3rd floor level. The Albert Court was finished by R.J. Worley’s designs between 1896 and 1900. The time it took to complete this building reminds me the troubled and long path that the Royal Albert Hall had to go in order to become the magic building the whole world envies to Britain. This building is made with red brick with elaborated stonework bands and dressings. It has 6 storeys, a D- shaped plan, with the North and East facades following the crescent line of the former Royal Horticultural Society’s Garden.”*

**Beit Hall:** *“Beit Hall, otherwise known as the Beit Quadrangle, is one of Imperial College London’s oldest and most historic buildings. It was funded by Sir Otto Beit in 1910, then director of the governing body of Imperial College. Initially it was a faculty building housing Biology and later converted to a student Hall. The band Queen is said to have performed here its first gig. Their music was definitely different to what I was used in the 19th Century. During term-time, it is one of the largest Halls of Imperial College providing self-catering accommodation to 340 students. But during the remaining 14 weeks Beit magically transforms into an international conference centre and hotel. The colour that architect Aston Webb chose for the bricks perfectly matches the orange of my beloved royal albert hall.”*

**Albert Memorial Statue:** *“Look at me! This statue, which represents me, is a memorial to the Great Exhibition. Until 1891 it stood in the garden of the Royal Horticultural Society, which used to be on the site of the Royal College of Music. Take a look at the inscription below this statue, which sets out how much money we raised from the Great Exhibition. Albertopolis actually all started with the Great Exhibition in 1851, which showcased Britain’s international role in the arts and sciences. It was the first of a series of world fairs for culture and industry, where scientists used to meet, discuss and share ideas and innovations. From the Exhibition’s success this area south of Hyde Park was established as a long-term legacy to celebrate science, technology, culture and the arts. We have seen how Albertopolis is home to some of the world’s leading museums, academic institutions and national organisations. Each one of these is continually evolving and expanding, through their buildings and the people who work in, study in and visit them. More than 150 years later Prince Albert and Sir Henry Cole’s legacy is still alive and well. Albertopolis is still at the heart of the arts and sciences.”*

## Appendix 2

### Appendix B

#### .0.1 Phase 2 - User Generated Audio Narrative

##### **Royal Albert Hall:**

Excerpt 1: *“These decorations you see under the roof remind me of pottery from ancient Greece”* - sound location: top right.

Excerpt 2: *“The reliefs remind me of the Greek reliefs in the British Museum taken from the Parthenon. They are definitely different but somehow I like the idea of relief representation that it comes from the Greek influence?”* - sound location: top left.

Excerpt 3: *“I used to dream of being a musician. Whenever I see the building, I wonder what it would have been like to be a musician, and I feel a bit of pity for my lost dream.”* - sound location: middle front.

Excerpt 4: *“The architecture of the façade is surprisingly similar to the San Felice Sul Panaro church near Modena, which sadly has been destroyed in the recent earthquake.”* - sound location: middle front.

##### **Royal College of Music:**

Excerpt 1: *“On both side of the main entrance there are musical themed reliefs, and in the spandrels above them are carved wreath motifs.”*

Excerpt 2: *“You can see the pilasters travel up the building and change into two small niches, which then move upwards and change into finials on the central dormer. This has a clock mounted in the top section with a triangular sun relief and strap work decorations.”*

##### **Albert Memorial Statue:**



Excerpt 1: *“I’m curious about the 4 statues placed in the base of the Albert memorial. Their attire looks different from each other, maybe they symbolise the 4 corners of the world?”*

Excerpt 2: *“In the other Albert Memorial in Hyde park there are some Marble figures and animals representing Europe, Asia, Africa and America at each corner. For the animals, Africa is represented by a camel, the Americas with a buffalo, Asia by an elephant and a bull for Europe.”*

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The following abbreviations are used in this manuscript:

HCI: Human-computer interaction  
UX: User experience  
CH: Cultural Heritage  
RtD: Research through Design  
UGC: User generated content  
UX: User Experience

