

Design challenges in promoting inclusion for cultural heritage contents through low cost technology.

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Abstract

The last two decades have seen a growing trend towards increasing the accessibility to cultural heritage contents. Recent developments in the field of interaction design have led to a renewed interest in investigating new methods to enhance the visitor's experience inside museums and other cultural points of interest. A new generation of low cost technology could act as a solution to the cognitive and physical issues that disrupt the visitor's experience and the access to the learning resources of the collections.

Data from several studies suggest that personalisation in the domain of development of cultural heritage can be fruitful in achieving a wider range of visitors and promoting inclusion. Since the museum experience can be composed by different cognitive, social and physical factors it can be vital to take into account these variables in order to design a better experience. With the intention of enhancing the museum experience, two field studies have been conducted. The first field study has been based on the analysis of visitors' behavioural patterns in a large scale archaeological museum in northern Italy. Visitors' movement and physical constraints, such as hyper congestion and fatigue, have been mapped with the aim to develop a Bluetooth sensor system that can act as a customizable mobile tour guide. This case was essential to investigate and define a preliminary categorisation of cultural sites' visitors. In the second case study, the discussion will verge on the use of similar low cost, proximity-based and location-based technologies, such as Bluetooth beacons and markerless augmented reality, applied to both indoor and outdoor contexts, to deliver alternate reality games. This case study includes 32 cultural and historical points of interest and an aqua zoo in Northern Jutland, Denmark. In this case, the research dialogue will focus on the visitors' interaction with the mobile, location-based content, and design challenges that emerged from a user experience point of view.

The purpose of this paper is to review recent research into the field of personalization of

cultural heritage experiences as well as comparing case studies conducted to explore the relationship between users and ubiquitous technology in cultural and historical points of interest. The main discussion will focus on how it could be possible to adopt interaction design solutions to tackle museum experience challenges while taking into account different design issues. Many issues can arise during the design of solutions based on new interaction frameworks and since new modes of interactions would be required, these new approaches may seem unfamiliar to the users. With different methods and personalization technologies it could be possible to manage different cultural contents in the most appropriate way for different audiences.

Keywords: *Guides, instructions, author's instructions, conference publications*

1 Introduction

Recently, researchers have shown that an increased interest in investigating technological applications to enhance the visitor experience can be crucial to engage 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 and cognitive issues from exhibition design and communication. In this paper, the physical issues we want to tackle are *hyper congestion* and *museum fatigue*, while the cognitive issues we will present are the users' illiteracy toward the digital media such as the difficulties encountered in the use of new technology, and issues in understanding new interfaces in situations where digital technologies are platforms for communicating the exhibition contents. These problems encountered by the visitors while engaging with cultural heritage content can affect the user experience and therefore the understanding of the objects they encounter during the visit. According to Bird (2015), the "*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.*" Therefore, if we assume that the nature of this cultural experience is completely voluntary, and leisure based, any kind of cognitive obstacle, physical or mental, can easily turn off the visitor focus and neutralize the learning activity that is a part of the visiting (Wittlin, 1970). There is a rich established body of research about design interventions to tackle aspects such as learning in museums through digital technologies, and following the long line stemming from the HCI tradition, we turn our gaze towards up and coming technology types. In recent times mobile devices and context aware technologies have gained attention and traction in exhibition. Digital experiences are designed and tested to investigate their capacity as technical platforms as well as capacity to deliver the information that the museum is looking to communicate. Everything from games, guides, augmented, virtual and mixed reality applications for personal mobile devices and tables following the "bring your own device" strategy, to permanent installations with audio or visual augmentations for the physical space and exhibition artefacts have been investigated in the existing body of research. In this paper we wish to discuss a specific class of context aware technologies, due to its low-cost and future proof attributes; namely Bluetooth beacons as points of interest (POI) for smartphone applications. This specific technology has been adopted due to its low cost and its flexibility in giving a robust medium to reach a wider audience in different settings, with minor modifications to the existing museums' displays and point of interests.

The aim is to enhance the engagement toward cultural experience and connect people with their own heritage by using beacons as the backbone for different type of systems. The working hypotheses of this paper is that beacons combined with smartphones can enable us to enhance the visitor experience by personalizing the cultural content to the end user, which promotes visitors' inclusivity and access to the content.

But how do we design personalized visiting experiences with low-cost non-idiomatic technologies to improve the cognitive and physical issues inherent to a visit? s
In this paper we will present different field studies that have been performed in museums and cultural points of interest (CPOI) and how cultural heritage (CH) fruition can be enhanced by improving the visitor experience. In the second part of this paper, we will review works that had a great impact on the shaping of the field's studies, subsequently in the third part we will describe the case studies and the methodologies. In the fourth part, we will discuss the results and develop the conclusions, and in the fifth part we will present guidelines for future work.

2 Related work

Recent developments in the field of museum studies have led to a renewed interest in the museum experience. This experience can be considered as the summary of all the visitor's interactions with the museum staff, with the display, the objects and the museum's program at large. This experience can be also applied to cultural points of interest, and can continue long after the visit (Falk, Dierking, 2016).

In 1970, Wittlin suggested that *"It should be a fascinating goal to search for the specific, intrinsic contribution [museums] can make to human well-being. We may then be in a position to answer the question "would we invent museums if we did not have them?"* Therefore, we can assume that it can be challenging to explore the museum experience's contribution to human well-being. This challenge itself can unveil the purpose of the exhibit engagement itself (Wittlin, 1970). As a consequence of this pursuit for a better experience, the improving of the visitor experience started by tackling the main issues concerning the museum fatigue and hyper congestion.

Museum fatigue and hyper congestion are highly stated problems with museum studies and are recognised to be the main disruptive variables of the visit. Previous research has established that museum fatigue can be triggered by different factors during the museum visit. A poor or confusing signage is one of these factors since *'searching for information to satisfy curiosity has the cost of both time and energy expended'* (Bitgood, 2006). Visitor fatigue can also be triggered from exhibitions that are spanning through a very long path and often require backtracking to see some missing artefacts. According to Bitgood (2006) *"exhibitions that require backtracking to see all of the exhibit displays are undesirable because visitors do not want to waste time and energy (which is likely to hasten fatigue)."*

Hyper congestion can also disrupt the visit, when the number of visitors exceed the space available, it can be really challenging to perceive the artefacts (Yoshimura et al. 2014). It is true that the overcrowding of certain public attractions can promote a CH site by showing its own popularity (Krebs et al. 2007), however we should keep in mind that a high density of visitors in certain spaces can be detrimental for the educational aim of the visit, and generally

cause stress for the visitors (Yoshimura et al. 2014) (Maddison and Foster, 2003, pages 173–174).

2.1 Navigation and visitor trails

With the aim to better understand the issues related to the visitor experience, in different studies it has been crucial to understand visitors' movement and behaviour inside the cultural heritage spaces. To map the users' navigation within the exhibits is essential in order to understand issues that can be detrimental to the visit. According to Bitgood, visitors only approach the artefact they perceive as the more attractive for them, however, *“only a very few objects are perceived as attractive enough to merit physical approach. Many objects may be viewed because they are in the visitor's circulation pathway and thus require little effort (no additional steps)”* (Bitgood, 2006). So we can say that a lot of efforts should be put in the path planning's design of each visit, in order to maximize the visitors' attention span on the objects. In addition, physical elements in the museum environment can discompose groups' aggregation, hence it can be difficult to coordinate group activities and promote connectivity between visitors (Jansen, 2008).

2.2 Personalisation in cultural heritage and low cost technological solutions

According to Kuflik (2011) in the last two decades a raising of mobile device technologies devoted to the engagement toward personal heritage focused on enhancing the cultural experience. This specific technology has been adopted due to its low costs and its flexibility in giving a robust medium to reach a wider audience in different settings. This technology, mostly sensors and mobile Apps, allows to enhance the museum experience with minor modifications to the existing exhibits, displays and point of interests. But how the level of personalisation can be helpful to engage with cultural heritage content? According to Ardissono (2011) personalisation can greatly enhance the museum experience since it's composed by different aspects. These aspects could take into account socio cultural values, physical condition of the visitor and identity related variables. Consequently, visitors *“may benefit from individualized support that takes into account contextual and personal attributes”* (Ardissono et al., 2011), because visitors' behaviour may *“not remain consistent during the visit and this may require ongoing adaptation”* (Falk, 2009). Numerous investigations suggested that is often hard to find artefacts that really trigger the visitor's interest, since the collection are sometimes are composed by many objects. Hence the quantity of objects inside a collection can be disruptive to fully appreciate a single artefact (Li and Liew, 2015). A recent case study by Marshall and Petrelli *et al.* (2013) also support personalisation as solution to enhance the visitor experience. To better engage with cultural heritage content they presented an Audio based narrative experience. This experience is related to World War I and is located in the Italian Alps, in an old fortified camp and trenches. The results of their study are quite innovative and show how *“an evocative embodied experience that does not describe the place in a traditional sense, but leaves its interpretation open”*

3 Research approach and case studies

In this paper we will present three field studies that have been designed to investigate context aware technologies potential to deliver experiences that span across digital and physical spaces. The common denominator is that they are all concerned with alternate reality games developed for or around attractions. Two of the cases (2 and 3) is a look to past iterations of context aware design interventions to deliver digital experience on personal mobile devices.

The third case is a novel approach to create a digital experience layer for exhibitions using Bluetooth beacons as the backbone. To reply to this question, further inquiries around the topic of personalisation emerged, such as how the level of personalisation can be helpful to engage with cultural content? How is it possible to enhance the visitor's experience and improve the engagement? And last but not least, how we can enhance the visitor's experience and improve the engagement.

3.1 Egyptian Museum, visitor behaviour mapping and path planning

In this case study an analysis on visitors' behaviour was conducted prior to designing a Bluetooth sensor system to help people orientating inside the museum. The first step of this study has taken place in the northern Italy, between the month of March and May 2016. A previous study has been carried on at the Louvre museum in Paris by the MIT Senseable lab, with the only focus to track visitors' behaviour with few Bluetooth sensors. The Louvre study was essentially exploratory, and focused on the visitors' movement without promoting a solution to hyper congestion and visitor fatigue (Yoshimura et al., 2014).

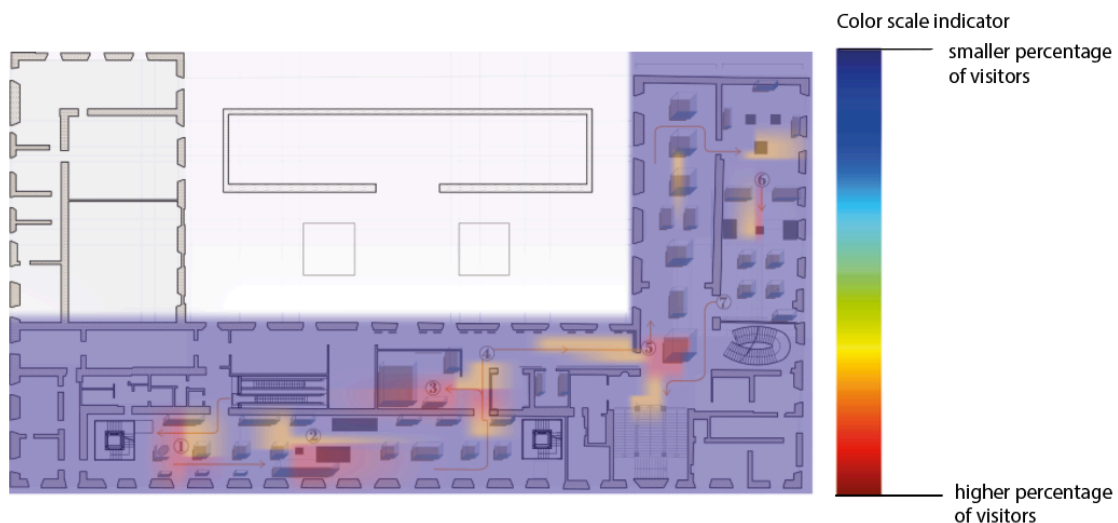


Figure 1. The heat map of the second floor of the Egyptian museum generated after the manual mapping and the observations. The colder colours indicate the less visited areas, while the warmer ones present a denser visitors' aggregation.

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Prior to design the proximity sensor system was essential to perform a manual mapping of the visitors' movements and behaviour by creating heat maps four floors of the Egyptian museum (Fig.1). After three months of observations and manual mapping was possible to identify the

most suitable areas to place the proximity sensors. This project is still ongoing, and on June 2018 there will be the first field test in the museum using 50 sensors and a preliminary version of a mobile App, that will suggest the personalised trails to the visitors and give in real time hints on the most congested areas in the building. The design of the sensor system has been improved not only with the guidelines given from the mapping, but also after a workshop session with the museum staff (curators, management and communication department) and the researchers, and a visitors' questionnaire that has been distributed to 35 visitors.

3.2 Alternate Reality Game, Noorhjem, Northern Denmark



Figure 3. Large poster including 3 step-by-step guide to Noorhjem and a small plate on a pole.

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.

3.3 Marker-less Augmented Reality, North Sea Movie Maker, Northern Denmark

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.

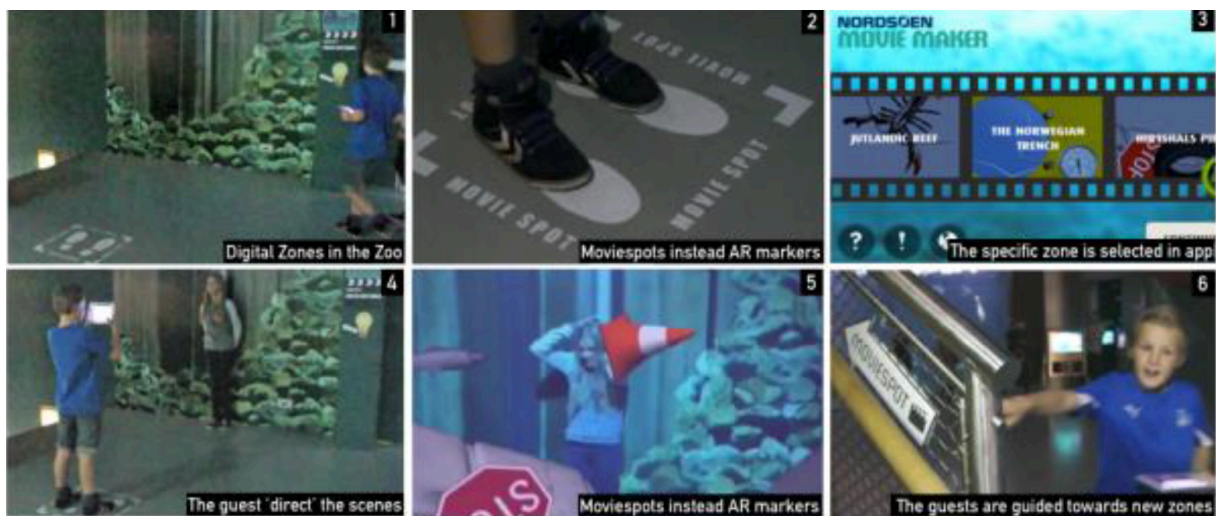


Figure 2. The user journey of the guest using the augmented reality app ‘North Sea Movie Maker’(Vistisen et al., 2017)

4 Findings and discussion

In the presented case studies, we can say from a technical point of view, we adopted the Bluetooth technology because, according to Faragher and Harle (2014), is low-cost, and requires low maintenance efforts. Proximity sensors have been broadly used for retail and commercial use, and they perform a more precise positioning.

It's true that Wi-Fi fingerprinting is the most widely used approach for indoor positioning, due to the widespread availability of deployed infrastructure. Importantly to note, the infrastructure access points are deployed for reasons of communication/connectivity and not for localization and Wi-Fi indoor positioning is a ‘power hungry protocol’ (Zhao et al., 2014). On the other hand, from a design perspective, we can say that an extensive visitor behaviour mapping can really make the difference in terms of decision making in order to propose a proper tool to navigate inside a museum space. However, the lesson learned from the Danish case studies demonstrate that many issues arise when a when a transition from manned and assisted introduction of non-idiomatic technologies, to implementation of non-idiomatic

technologies in unmanned settings (Vistisen et al.,2017). We can say that the current trend dictating the rise of unmanned attractions can be helped by designing with caution non-idiomatic technologies and interfaces. Since the recent economic constraints for an increasing number of cultural heritage attractions are giving less funds to implement the visitor experience.

5 Future works and guidelines

As we described in the previous sections, the main guidelines emerged from the case studies discussed in this paper are highlighting the need of a personalised technology that can enhance the visitor experience. This technology should be low cost, in order to allow economical constraints often faced by several cultural heritage sites. In addition, the adopted technology should be able to overcome user's basic illiteracy and allow an intuitive use of the provided interfaces, in order to allow wider range of visitors to interact with the artefacts. The interaction with the artefacts should create inclusivity within the public and promote new opportunities to encounter new knowledge.

It's possible to measure the engagement of a visitor experience by adopting new new ways of thinking and "provide new opportunities for individuals to invent personal knowledge and explore new ideas and concepts". If the visitor experience present new challenges people can have a chance to discover and connect to new knowledge, that can lead to personal growth (Soren, 2009).

In addition, is essential to support the museum visitors' affiliation, a vital issue to connect and build links before and after the visit, by creating hype around specific collection and promoting the visitors' come back.

In conclusion we can say that efforts toward an enhanced visitor experience have been triggered by an increasing awareness toward cultural heritage contents aimed to promote better accessibility. Those intents have been supported by an always increasing trend of testing a more cutting edge technology that becomes more ubiquitous and more affordable. Accessibility and awareness are fundamental concepts to take into account in order to reach a broader range of visitors, and expand the audience of cultural contents.

Acknowledgement

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