
Build Your Own Hercules: Helping Visitors Personalize their Museum Experience



Figure 1: When visitors (child, group of adults) arrive at the museum, they can choose their personalization characteristics thanks to *Build Your Own Hercules*, a tangible token+constraint interface.

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ABSTRACT

Museums compete with the entertainment industry to attract a large audience. One solution to make them more attractive is to personalize the visits according to visitors' preferences. Following a user centered design approach with visitors and museum professionals, we designed and implemented *Build Your Own Hercules*. This tangible prototype helps groups of visitors or individuals choose a visit based on their characteristics and desires. A pilot study in the museum provided first insights about the ease of use, satisfaction and interest within visitor groups.

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KEYWORDS

Tangible interaction; token+constraint; museum; personalization; user-centered design

Table 1: Characteristics extracted from the user analysis with visitors and museum professionals

<i>Museum professionals</i>	<i>Visitors</i>
Number of visitors	
Age	Language Children/Adult
Available time	Duration
Potential disability	Mobility
Motivation	Interaction, Playfulness
Expertise	Content difficulty level
Theme of the visit	Theme, points of interest

Table 2: Final characteristics for personalization

<i>Visitor characteristic</i>	<i>Values</i>
Group composition	single adult, couple, group of adults, family
Available time	30min, 1h, 2h, 3h, +3h
Motivation	having fun, learning, discovering
Expertise	beginner, intermediate, expert
Theme of the visit	mythology, heroes, etc.

INTRODUCTION

With the growing competition of entertainment industry, museums are facing new challenges. They must reach a wider audience, build local visitors' loyalty and tailor their content to the diversity of this public. Relying only on temporary exhibitions or guided tours is too expensive for small museums which makes it hard for them to diversify their visit offer. Moreover, guided tours have the disadvantage of being constrained to certain hours of the day, as well as specific topics. The personalization of visits, depending on visitors' characteristics, behaviors and wishes is a possible solution to meet these challenges [16]. Adapting both cultural content and narrative allows to target all kinds of visitors and to reveal multiple points of view on the permanent collection [13]. Even in small museums, each artefact has various facets that can be combined into different stories. It is also in line with the objectives of museum professionals to break away from the top-down transmission of knowledge and to start bottom-up from the desires and characteristics of their visitors. To do so, they need to collect such information from their audience [1]. Data gathering can be done explicitly, for example through quizzes or questionnaires [19], or implicitly by inferring from in-situ behavior [2], the use of digital visit guides [23] or visitors' social networks [14]. These solutions, however, rarely deal with groups of visitors and the implicit data gathering makes it difficult for users to fully perceive and understand personalization [5].

We therefore aim at creating an interface which allows to explicitly collect the desires and characteristics of museum visitors, whether alone or in groups, in order to offer them tailored self-guided visits. Tangible User Interfaces (TUI) have the potential to meet this challenge, as they foster collaboration [21] and help to promote public engagement and participation [6]. Following a user-centered design approach [7,15] in several steps (user analysis, creation of ideas, low and high fidelity prototyping), we gathered the needs of visitors and museum professionals and codesigned with them a tangible solution: Build Your Own Hercules. This prototype, based on the token+constraint principle [24], allows visitors to select their characteristics and desires at the entrance of the museum, and then proposes personalized visits accordingly (Figure 1). A pilot study was conducted in the archeological museum Saint-Raymond (Toulouse, France) during four hours to collect user feedback under real conditions. 22 visitors (six groups and eight individuals) tested the prototype. The first feedback provides insights into ease of use, satisfaction and interest.

RELATED WORK

Tangible interactions have often been used in the context of museums [3,4,12], as they facilitate engagement and collaboration [9]. However, they have rarely been used for the choice of personalized visits. In the meSch project [17], visitors could pick a tangible replica, representing a specific point of view on the exhibition, at the entrance of the museum. Placing the replica on dedicated areas throughout the exhibition triggered specific narratives according to the chosen point of view. Another use case of meSch presented an augmented audio book with physical bookmarks for choosing the theme of the audio content, depending on the localization in the museum. Both use cases proposed personalization based on theme and localization, but they do not consider the characteristics of the groups of visitors.

Museum guidelines

- R1. Allow parallel use by several groups
- R2. Allow the creation of subgroups
- R3. Encourage negotiation within the group
- R4. Do not require the presence of all group members to choose
- R5. Preserve the privacy of the group
- R6. Consider the after-visit (goodies)

Interaction guidelines

- R7. No learning phase required
- R8. Suitable for all audiences, including children
- R9. Reversibility of actions, incremental steps

TUI guidelines

- R10. Encourage participation by attracting attention
- R11. Promote collaboration with shared objects
- R12. Foster engagement to encourage reuse

Figure 2: List of design guidelines

	Hercules	Column
R1. Parallel use	-	+/-
R2. Subgroups	-	-
R3. Negotiation	+	-
R4. Not all required	+	+
R5. Privacy	-	+
R6. After-visit	-	-
R7. No learning	+	+
R8. All audiences	+	-
R9. Reversibility	+	+/-
R10. Attractivity	+	-
R11. Collaboration	+	-
R12. Engagement	+	+
Total	4	-2

Figure 3: Evaluation of two prototypes according to the design guidelines

TUIs also help to meet the challenge of public engagement more effectively than graphical user interfaces. For instance, to encourage visitor participation, BiebBeep a large touch screen was used to provide information in a library [10]. An interactive floor prototype called iFloor [11] was installed to stimulate interaction between people in a library. However, in both cases, few people passing by these devices actually used them [8]. TUIs in turn attract the attention and encourage the participation of passers-by, as has been shown with Voxbox, a tangible public opinion gathering device [6].

The goal of our work is to design a tool that allows museum visitors to choose self-guided tours in museums based on their characteristics. In line with these previous studies, we have chosen to use TUIs to attract museum visitors. We extend the existing work by using visitors' characteristics for personalizing their visits rather than theme or localization.

USER NEEDS ANALYSIS

In a user-centered design approach [15], we conducted a user needs analysis with both kinds of stakeholders: museum visitors and visitor service professionals. We aimed at better understanding the current process of guided visits and collect the wishes for future self-guided personalized visits from both sides.

Museum specialists

We conducted four semi-structured interviews with two cultural mediators and two visitor service managers of three cultural institutions (fine arts museum, wine culture foundation and archeological museum). We wanted to understand how they currently build and conduct guided tours, and how they imagine future personalized self-guided visits. For all interviewees, the ideal future museum visit is a visit that adapts to the visitors, depending on their desires, needs and feelings. We extracted from these interviews six main characteristics of visitors to consider when personalizing visits (Table 1 first column), in addition to the theme which is imposed by the museum rather than by the visitor. These findings are consistent with previous work which identified similar visitor characteristics, like the expertise or the motivation [25].

Museum visitors

We conducted semi-structured interviews in the archeological partner museum with 13 groups of 37 visitors for gathering qualitative feedback about wishes in term of personalization. Additionally, we sent an online questionnaire by email to the subscribers of the museum newsletter and shared it on the museum's social media in order to confirm the first findings with a wider audience and more quantitative data. We collected and analyzed 133 answers for the online questionnaire.

Most of the respondents would be interested in following a personalized visit in the museum (78% gave a score between 5 and 7 on a 7-point Likert scale with 1 corresponding to "not at all interested" and 7 to "very interested"). The interviews revealed that most visitors would like to choose between two to three visit proposals filtered according to their wishes and characteristics.



Figure 4: Participatory workshop and low fidelity prototyping

We also extracted the characteristics for personalizing visits which are relevant for visitors (Table 1 second column). These characteristics are in line with those proposed by museum professionals (Table 1 first column). The number of people in the group does not seem to be a criterion for visitors. However, this is a technical constraint for museum professionals who are concerned with the good visibility of small exhibits or the overcrowding of small spaces.

Table 2 shows the final selection of personalization criteria which we obtained by intersecting the results of both studies and refining them with the visitor service manager of the Saint-Raymond museum according to the achievable visits in the museum.

We also listed a set of 12 design guidelines (Figure 2). They were extracted from the discussion with museum professionals (R1 to R6), the literature in HCI [20,22] (R7 to R9), and properties observed in related work [6] (R10 to R12). They were also used in our previous work [18].

COLLABORATIVE DESIGN OF *BUILD YOUR OWN HERCULES*

In a second step of the user-centered and iterative design approach with mediators and visitors, we aimed at creating ideas for the design of a tangible tool for the archeological partner museum.

Ideation and low-fidelity prototype

We organized a two-fold design workshop in the Saint-Raymond museum: a first part consisted in a brainstorming session and a second one in low fidelity prototyping. The workshops lasted two hours and involved 13 participants. The participants had various profiles: two museum visitors, three museum professionals (curator, cultural mediator and visitor service manager), three HCI researchers and four HCI students. Participants were recruited through our networks and social medias. They were divided into two groups with balanced profiles and were asked to imagine how to help visitors choose visits according to the given characteristics (Table 2) and beyond the classical use of screens and touchscreens. After a phase of brainwriting and brainstorming, the participants voted for their preferred ideas. Pairs of participants created mock-ups of the six preferred ideas (two of them shown in Figure 4).

After the workshop, we evaluated the low-fidelity prototypes according to the design guidelines (Figure 2). This resulted in scores for the six prototypes (Figure 3 shows the result for the two best rated prototypes). This allowed us to choose the prototype that matched our criteria best: *Build Your Own Hercules*. On arrival in the museum visitors equip Hercules with his demigod attributes—i.e. their characteristics and desires—before his initiatory journey—i.e. their visit of the museum.

High-fidelity prototype

In this step, we refined and tested the low-fidelity prototype in order to iterate on the solution and create a functional version. The final prototype consists of a wooden inclined plane representing an epebe statue exposed in the museum, transformed into Hercules by adding his attributes. The statue has five slots of various shapes at different body parts and five sets of wooden tokens



Figure 5: *Build Your Own Hercules*, a statue of Hercules with five slots (constraints) and five sets of pieces (tokens).



Figure 6: Each slot can hold a token of matching shape and color.

representing Hercules' attributes (Figure 5). Each slot corresponds to a visit characteristic listed in Table 2. Each set of wooden pieces matches the corresponding slot in form and color: waist belts² for group compositions (single adult, couple, etc.), anachronistic watches³ for durations (30 minutes, 1 hour, etc.), tools for motivations (have fun, learn, discover), beards³ for expertise (beginner, intermediate, expert) and lion's coats⁴ for themes (mythology, archaeology, heroes, etc.).

Use of *Build Your Own Hercules*

Inserting a wooden piece within a slot represents the selection of a value for a specific characteristic of the visitors. For each association, a LED placed near the area lights up to confirm that the choice has been taken into account. This system is completed by a screen, at the feet of Hercules, displaying the three visit routes that best match the chosen criteria. The list is updated dynamically from the first choice and with each new choice of value for a characteristic.

Implementation of *Build Your Own Hercules*

A passive RFID tag is used to identify each of the 26 tokens. One RFID reader (MFRC522) is placed behind each slot to identify the embedded piece. An Arduino Mega manages the system's inputs and outputs: five RFID readers for detection on Hercules, five LEDs for feedback on Hercules and push buttons for choosing the visit on the screen. A Raspberry Pi 3 hosts the software and database to store identified pieces and proposed visits. The list of proposed visits is updated according to the selected characteristics. The result is displayed in a web application (View.js) on the screen connected to the Raspberry Pi.

In a dedicated part of the application, the museum professionals can add or remove pieces easily. This allows to dynamically adapt the application to changes in the museum.

According to the classification of tangible interfaces by Ullmer et al. [24], this prototype follows the principle of *token+constraint* interfaces. Tokens embody digital data while tangible constraints embody digital functions. In *Build Your Own Hercules*, each piece is a token embodying a possible value and each slot is a constraint embodying the choice for a characteristic (Figure 6).

PILOT STUDY IN THE MUSEUM

Build Your Own Hercules was installed in the entrance of the Saint-Raymond museum for four hours (Figure 1). 22 visitors of different ages (six groups and eight individuals) experimented the prototype in autonomy in the presence of the experimenters. The observation was followed by a quick interview on the ease of use, satisfaction and interest of the system.

The feedback was generally positive. Visitors rated the difficulty of use at 2.01 on a 5-point Likert scale from 1 (simple) to 5 (complex). Only three participants had difficulties interacting with the system. They wondered whether they should start the interaction on the touch screen or on

² The girdle of Hippolyta, Amazonian queen, is at stake in the ninth labor of Hercules.

³ The beard of Hercules makes it possible to identify his age on the representations of the 12 labors.

⁴ The Nemean lion is the first of Hercules' 12 labors

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Hercules. A more “integrated” solution with a projection of the proposed visit on Hercules’ body or a screen placed at a different body part could solve this problem. For most users, the system was enjoyable. Only two people were a little hesitant. One group of users was disappointed as they did not want to be guided in the museum but explore on their own and could not believe that the museum could offer so many visits due to its small size. 13 of the 14 groups of visitors found the system useful and appropriate.

The syntax of the tangible system, which resembled the interaction with a puzzle, was very well understood by visitors. This is in line with the results of Ullmer et al. on tangible *token+constraint* interfaces providing a clear syntax of use [24]. Some found that the multiplicity of pieces gave a good picture of the multiplicity of possible visits in the museum. 11 of the 14 groups of participants completed all slots, although this was not mandatory. The reason may be the metaphor, as visitors want to complete the puzzle entirely.

The attractiveness of the tangible prototype was harder to evaluate. At least 68 people naturally approached the system (including the 22 who tested it), for 135 total museum visitors over the same period according to the ticketing system. We observed visitors who wanted to interact with the system but left since it was already used by another group. The new temporary exhibition, whose entrance was located just next to the system, strongly attracted visitors from the permanent collection and *Build Your Own Hercules*. However, we can note that the tangibility of our prototype seems to attract people more than the 10% reported for the screen in BiebBeep [10], some visitors even approaching to touch tokens on the table while others were interacting.

We observed that in two thirds of the cases (four out of six groups), the group split into one person actively manipulating and several observers. In two groups, the adult manipulated alone without involving the rest of the family. In one group, the adult manipulated and discussed intensively with his kids. In another group, the child performed all the manipulations, discussing each choice with the parent. In the remaining third of the cases, we observed manipulations by several people: two teenagers who discussed extensively while jointly handling tokens, and a family member who transferred manipulation to another during the completion of Hercules.

CONCLUSION

In a user-centered design approach with museum professionals and visitors, we designed *Build Your Own Hercules*, a tangible *token+constraint* interface that allows museum visitors to select a personalized visit. The first feedback from the pilot study provides interesting insights into the ease of use, satisfaction and interest of the system. Users generally rated the system as simple, enjoyable, useful and appropriate. We also identified ideas for improvements, such as better integrating the display of proposed visits within the tangible interface. Further studies are needed to evaluate the user experience, attractiveness and engagement. *Build Your Own Hercules* induced discussions about choices in two thirds of the groups and joint manipulations in one third. These first elements of collaboration need to be further explored through appropriate experimentations.

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