Moving through the past: Design and Evaluation of a Full-Body Interaction Learning Environment for a Public Space

[2 page summary]

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ABSTRACT

This paper presents a brief overview of the design and evaluation process of a Virtual Heritage (VH) experience for children in the context of Refugi 307, a bomb shelter built during the Spanish Civil War. The shelter currently belongs to the History Museum of Barcelona, which provides guided tours through the cultural heritage site for schools and the general public. The goal of the study is to evaluate suitable design methods to define the requirements for the design of a first prototype grounded on the World-as-Support (WaS) interaction paradigm, which is based on projective Augmented Reality (AR). We conducted an ethnographic study and Participatory Design (PD) workshops in order to analyse different aspects of the requirements and to include multiple needs and viewpoints of the involved children.

CCS CONCEPTS

• **Human-centered computing** → Mixed / augmented reality; Participatory design

KEYWORDS

Full-Body Interaction; Augmented Reality; Virtual Heritage; World-as-Support; Learning; Participatory Design; Children; Embodied Cognition

1 INTRODUCTION

"Heritage sites are an important part for understanding our role in history. They have the potential to teach us important lessons, such as where we came from and subsequently, the people it has made us today" [1]. Multimedia and virtual technology have a lot to offer to heritage, i.e. hidden experiences or vanished aspects of the site can be highlighted through virtual experiences [2], yet virtual heritage environments are only viable when the system is satisfactorily designed. A wide range of technologies which support screen-based interfaces, such as smartphones or tablets, have been explored in museums and cultural heritage sites. However, these technologies tend to draw user attention away from the physical environment and other visitors, to a framed window which is likely to isolate and provide an individual experience [3].

Moreover, site-specific spaces can rarely be altered by adding physical objects or installations, thus cultural heritage visits are often complemented by guided tours to direct visitors' attention towards aspects that might not be noticeable without further explanations. Nevertheless, visitors still need to imagine missing artifacts, or related events. Due to limited knowledge and the lack of previous experiences, it may be particularly difficult for children to imagine some of these contents and situations.

On the other hand, at a design level, teachers and learners are rarely included in the design process and, in doing so, experts only pay attention to specific aspects which ultimately exclude how children make sense and construct meaning during the experience.

2 DESIGN OF A VH EXPERIENCE FOR THE BOMB SHELTER REFUGI 307

To tackle the stated challenges, we present the design process of an initial prototype in the context of a site-specific learning experience for a CH site. The prototype is grounded on the emerging interaction design paradigm WaS [4]. This paradigm is based on projective AR and embodied interaction, i.e. children can augment their physical surroundings by situating virtual content on the physical surface via a handheld projector. Consequently, the resulting portable system differs from screen-based technologies in that it incites environment and social awareness, and enables children to become part of the experience itself [5][6][7].

In addition, it also offers the potential of bodily and tangible interaction, which can trigger various forms of exploratory behaviours, strengthening their awareness of 'being present on the site' and facilitate collaborative interaction and perspective-taking by allowing children to adapt different viewpoints upon a specific topic.

On the other hand, the suggested design and evaluation process is grounded on PD methods to appropriately support children, teachers and museum experts to cooperate throughout the process, and give the young children a voice in designing new technology [8][9].

Based on this, our study was carried out in the context of a cultural heritage location; namely the Refugi 307. The site is one of the 1,402 bomb shelters that were built by civilians during the Spanish Civil War in Barcelona, aimed at protecting the

population. This shelter is nowadays part of the History Museum of the city, who provides guided tours through the site.

2.1 Procedure

We conducted an ethnographic and PD study to analyse the project's requirements and include different needs and viewpoints of the involved stakeholders. A total of 39 children (girls = 18; boys = 21) aged 10 to 12 participated in the research.

The first session lasted 120 minutes and included a guided tour through the shelter and PD activities. After the tour, children were asked to fill out an open-ended questionnaire aimed at assessing their interests, understanding and preferences in relation to the learning topic and the physical space.

Children were then divided into groups of 3-4 members and instructed in an activity based on the KidReporter technique [10]. They were asked to record a 2-minute video about the place of the shelter they found most interesting. Afterwards, we handed out a map of the shelter and prompted the groups to choose one place of interest and to brainstorm how they would perform the interview.

The second session was held in the school and lasted 180 minutes. Children were again divided into the same groups. Using the maps of the shelter, they were asked to elaborate on the places they remembered and had caught their attention the most. Children wrote their comments on post-it notes and placed them on the map. We interviewed each group individually during the activity.

After that, they received a different storyboard template about the Spanish Civil War and were encouraged to think of a narrative related to it with the aim of evaluating their interests and personal values in relation to the learning topic.

Children were then instructed to re-design the guided tour according to their own interests and preferences. We explained our interactive technology approach to them based on pico-projectors and they were then asked to produce low-tech prototypes we called "spotlights"; i.e. children drew on transparent plastic and placed them over one end of a paper roll which had a flashlight inside. This simulated the projection capabilities of the final handheld device. Finally, each group gave a 5-minute presentation to explain and enact their ideas with the low-tech prototype.

The third session was again held at the school and lasted 60 minutes. Children were given open-ended questionnaires related to perspective-taking and collaboration. Then, children were again divided into the same groups. Each group was then given two pico-projectors and prompted to imagine that the classroom was the public space of the shelter and to re-enact the guided tour visit by using the handheld devices. Once finished, the group followed a semi-structured group discussion about the individual results in order to obtain additional information about their comprehension of the experience in order to investigate how children children understood the system and how could their interaction with the prototype be improved. During all PD activities, we recorded short video interviews with each group while they were working on their proposals. The aim was to capture their different ideas and reflections during the design process.

2.2 Results

The use of PD activities in different formats allowed us to assess and analyse children's contributions through a broad set of multimodal resources. By contrasting the employed PD activities between two conditions, we showed how incorporating the physical space in the design activities shaped children's perception towards the cultural heritage site and learning topic. Our findings indicate that, on the one hand, the opportunity to "revisit" the shelter through a playful activity helped children to reflect upon the relation between the physical space and the learning content. On the other hand, the use of the notion of the space primed children's interpretations, emotions and behaviour at different levels.

On the other hand, our approach helped us to define key requirements for the design of a learning experience for this cultural heritage site. Our observations confirmed that the guided tour could benefit from the WaS paradigm since projective AR content allows to draw children's awareness to the environment by projecting missing content in their original locations; e.g. the signs describing shelter behaviour rules can be projected on areas of the walls that are now empty. It can also raise consciousness about historical events of the local context by projecting situated audiovisual content; e.g. project a testimonial of a woman who volunteered as a nurse in the space that was dedicated to the infirmary of the shelter. Also, the resulting system can split content between multiple users, each having a WaS device, and foster movement-based collaborative activities; e.g. two users project each a different half of an object that needs to be recomposed through their collaboration, which fosters social awareness.

4 CONCLUSIONS

In this paper, it has been concluded that there are benefits to complement the guided visit by using projective AR to explore different layers of the learning experience as well as participative activities that promote collaborative learning. Moreover, PD techniques are beneficial since they give children a voice in the design of learning experiences based on the WaS interaction paradigm. Further, they elicit spatial awareness.

Future work will include further exploration of different formats of the guided tour in combination with the virtual experience. This procedure could permit them to explore aspects of the experience motivated by their own interests and leave them more time for discovering new aspects of the learning content at their own pace.

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