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Madsen, Claus B.; Madsen, Jacob Boesen; Morrison, Ann

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C. B. Madsen, J. B. Madsen, & A. Morrison

Department of Architecture, Design and Media Technology

Aalborg University

ABSTRACT

The paper critically evaluates central aspects of an iPad AR application developed for a museum context. The application is designed for children aged 8 to 12 and mixes AR and mini-game elements to convey dramatized historical events. The game has been deployed for roughly 3 months and the findings in the paper are supported by extensive in-application activity logging. Actual usage of the application at the museum proved far less extensive than envisaged. Hypotheses for this finding are presented and discussed, with support from the logging data.

Keywords: Augmented Reality, edutainment, infotainment, museum, iPad, game, children, embodiment, visual exploration

Index Terms: K.3.1 [Computer Milieux]: Computers and Education—Computer Uses in Education; H.4.3 [Information Systems]: Information Systems Applications—Communications Applications; I.3.8 [Computer Methodologies]: Computer Graphics—Applications

1 INTRODUCTION

We describe an Augmented Reality (AR) based interactive experience designed for a museum, but it is not a typical success story. A number of design decisions were made, which turned out to prevent the designed experience from living up to its potential. We expose and discuss these flaws, and provide guidelines for improvements that can be useful for practitioners and researchers in related contexts.

Koldinghus Museum in Kolding, Denmark, is a castle dating back to the 13th century and has played a central historical role as part-time residence for a row of kings. The AR game/experience is called *Memories of The Walls*, and the story-driving element in the game is the walls (personified as a character) of the ruin remembering and letting the user experience dramatized historical events that occurred at Koldinghus.

The application is developed for children and pre-teens, runs iPads, and uses the AR concept as its main technological focus. The partners on the project have been Koldinghus Museum (contractor), the Board of Tourism for Southern Denmark (project management and funding), Aalborg University (technical development and implementation), No Parking and Baaring Stories (concept, manuscript, asset production).

The museum has been handing out iPads with the *Memories of the Walls* app to visiting children and their families since the launch on February 9th, 2012, (Figure 1). In this paper we perform a longitudinal study of the use of the app, based on in-app activity logging, in addition to conducted interviews, and qualitative observations of groups interacting with the app.[1]
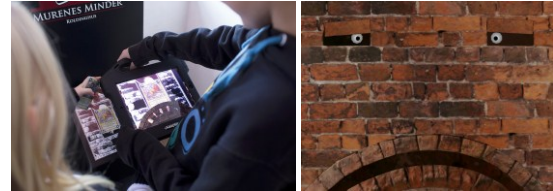

[cbm/jbm/morrison]@create.aau.dk

Figure 1: Left, two children playing *Memories of the Walls* with iPad in rugged casing. Right, screen shot from the developed app showing the wall character with eyes and mouth. The wall characters presents back story and quests to the user.

2 STORY AND THE GAME

The experience is centered around a "if only the walls could speak" concept. The *Wall* provides narration and quests by addressing the user directly, and users get to play through one of a series of wall memories. One memory is fully designed and implemented: the memory of Kirsten Munk, who from 1615 to 1628 was married to King Christian IV and bore him 12 children. Kirsten Munk was nobility but not royal, and could not be Christian IVs formal queen. The story implemented in the *memory* of Kirsten Munk is that the King's sisters are plotting to poison Kirsten Munk in an attempt to thwart her marriage to Christian IV. The quest of the child(ren) playing *Memories of the Walls* is to prevent the murder. The actual game experience takes the user through a large part of the castle while playing mini-games and unlocking items needed to complete the quest.
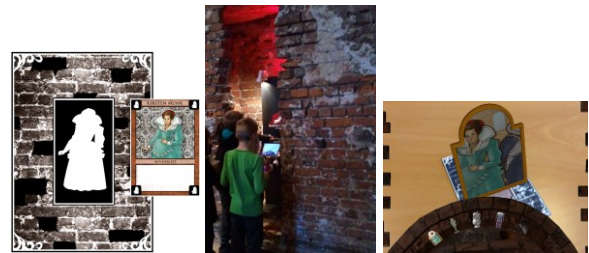

Figure 2: Left to right: 1) a static frame placed on a stand in the Castle Chapel, and the memory card of Kirsten Munk, 2) a stand in a recess in the Chapel wall, and 3) animated augmentations are displayed when the user places a proper card on static frames around the castle.

Memories of the Walls is an application for iOS 5.0 iPad2 tablets. The application is developed in the Unity game engine using Qualcomm's augmented reality SDK (QCAR) for tracking. In-app logging collects time of completion for individual parts of the game, total playtime, and progress in mini-games. During game stages entailing augmenting the position and orientation of the tracked marker relative to the iPad camera is logged at 2 Hz.

3 LONGITUDINAL STUDY

Usage data of the application has been logged on the 6 museum iPads from March 8th 2012 to May 9th 2012. During this time the

application has only been used 54 times. One third (18) played alone, while the remaining (36) played in a group of two or more. Only 33 (61%) ventured further into the game than the introduction. The average playing time for all participants is 38 minutes, whereas average playing time for those that complete the game is 65 minutes. Subsequently, we address three main problem areas we have identified from the longitudinal study.

3.1 Making it past the introduction

Log data shows that, *if* users made it past the introduction 88% (29 out of 33) complete the game. Apparently, the introduction represents a hurdle to users. The introductory stage of the game is not really completed before users make it to the chapel and launch the presentation of the back story on Kirsten Munk. The average time to accomplish this for the users that complete the entire game is roughly 12 minutes, so on average it takes 12 minutes before gaming, interaction and the AR "wow" effect kick in.

3.2 Reality not augmented

The goal of AR technology is to augment the physical world, but we noted that most groups spent more time looking at the screen and playing the games and only noticing the museum itself as if in passing, in a quest to find the static frames and locations of mini-games. The game is an orienteering exercise too focused on playing mini-games and getting from station to station. This is substantiated by the logging data. Average playing time for those that complete the game is 65 minutes, roughly 45 minutes of which is spent on moving from station to station across the entire castle. People who know their way around the castle are estimated to be able to walk that tour in under 10 minutes. Thus, on average roughly 35 minutes are spent on figuring out where you are and where you need to go.

3.3 Visual exploration in AR sequences

In *Memories of the Walls* there are 5 stages where animations are augmented onto the video feed. The in-app logging allows us to data-mine the positions of the iPad relative to the markers at the stages. Figure 3 shows a heat map of viewing positions (viewing directions projected onto unit circle) for the station where Kirsten Munk is introduced. The plot clearly shows that users do not exploit the possibility to visually explore the augmentations from arbitrary viewing directions. Had they looked more evenly from all viewing directions the plot would not have shown such a clear hot spot. This is clear evidence that users do not get the "wow" effect of tracked AR; they are passively watching an animation that might as well have been a regular 2D animation.
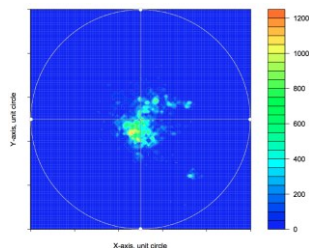

Figure 3: Heat map of viewpoint positions relative to the Kirsten Munk augmentation.

4 DISCUSSION

We subsequently present some alterations/improvement we believe would alleviate the problematic issues.

Abbreviate the introduction sequence. The design team behind *Memories of the Walls* championed a cinematic style presentation of the setting for the experience. Based on the longitudinal experiment we suggest that the experience be altered to a more game-oriented, explorative style, and design the introductory stages such that an interactive AR "moment", or "wow" effect occurs immediately upon starting the game.

Make the game more grounded in surroundings. Nothing in the gaming experience forces the user to take advantage of, or to "need", the surroundings while playing. We recommend changing the gameplay towards actively involving the surroundings, e.g., getting codes or names from paintings, counting the number of doors, locating the best place to hide and pointing it out on displayed floor map, anything that forces the users to take notice of the space and perceiving it, not just sensing it.

Motivate visual exploration during AR sequences. Data showed that users do not visually explore the augmentations. We suggest that this is addressed by 1) move stands from wall recesses into open floor space to allow users to walk around animations, 2) design augmentations to provide occlusions, for example multiple objects near each other, forcing the user to move in order to create motion parallax, 3) design mini game elements that force users to look behind/around objects to find, e.g., a year of manufacture or a code, 4) have static marker frames placed on the floor to enable body-sized augmentation which require actual body movement to walk around, not just a swaying from side to side. We conjecture the embodiment of the visual experience to be really important for the perception of the augmentations being grounded in the real environment.

5 CONCLUSION

During design and development there was a clash of cultures between the design people voting for a cinematic style, and the implementation people voting for an interaction-oriented style. The longitudinal study clearly indicated three issues with the current design: 1) the introduction sequence is too long and not interactive, 3) the physical location is not sufficiently integrated into the experience, and 2) augmentations are only experienced as cinematic cut-scenes, not visually explored.

We believe these experiences indicate that there is still a lot to be learned about how to design good applications around AR and how to optimally exploit the affordances of AR for interactive edutainment applications.