

# Please Touch the Exhibits! Using NFC-based Interaction for Exploring a Museum

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## ABSTRACT

Museums often use mobile devices and applications to let visitors explore their exhibits and interact with them in order to make the user experience more immersive and enjoyable. This paper presents a mobile museum guide based on the physical interaction with a dynamic NFC-display, consisting of a grid of NFC-tags and a projected GUI. Visitors can browse tours on the public display, download them onto their mobile devices and use them for the exploration of the museum. The paper presents the design of the museum guide, a first prototype and a preliminary evaluation of its usability and the interaction with a dynamic NFC-display.

## Categories and Subject Descriptors

H.5.2 [Information Interfaces and Presentation]: User Interfaces – input devices and strategies, interaction styles

## General Terms

Design, Human Factors

## Keywords

Multi-Tag Interaction, NFC, mobile guide, learning environments

## 1. INTRODUCTION

Museums combine science and entertainment to attract and educate children and adults alike. For that purpose, many museums have adopted multimedia guides or have added interactive elements to exhibits to increase their educational value in a playful way, to let visitors explore a museum and to make the overall user experience more enjoyable. These services are often provided through customized mobile devices but can also be realized with regular mobile phones or PDAs. Previous research on museum guides has taken advantage of their capabilities to extend traditional guides with multimedia features [1], context-awareness [4] or new interaction modalities. In [3], Mantjarvi et al. present a mobile museum guide that uses RFID-tags to identify artworks and tilt gestures to navigate the interface and multimedia features of the application.

This paper presents a prototype of a personal, mobile guide that supports the exploration of a museum on a public display and

accompanies visitors through the museum. Visitors start the interaction with the guide on a dynamic NFC-display [2] that projects the application's interface onto a grid of NFC-tags. Users can touch these tags with their NFC-enabled mobile phones to manipulate the projected interface and the features of the application (see Figure 1). That way, visitors can browse different tours through the museum, create new ones, download them onto their mobile devices and use this information (e.g. floor plans, information about exhibits) for the exploration of the museum.



Figure 1. Interacting with the museum guide on the dynamic NFC-display

The application of the dynamic NFC-display is motivated by its improved input- and output capabilities compared to constrained mobile devices as well as the directness and intuitiveness of its physical interaction. Therefore, this paper investigates the applicability and usability of this novel interaction technique in the context of a mobile museum guide. The next section provides more details about its first prototype. Section 3 describes a preliminary evaluation of its interaction design and section 4 concludes the paper with a discussion of future extensions.

## 2. DESIGN AND PROTOTYPE

The prototype of the museum guide comprises two parts: a server application including the dynamic NFC-display and a complementary client application on a mobile device that interacts with the display. Figure 2 shows the basic setup of the dynamic NFC-display, whose design and implementation is based on previous work that has used a grid of NFC-tags for mobile interaction with static [5] and dynamic physical interfaces [2]: The server manages

the application logic of the museum guide and stores information about its different tours, including duration, themes, target visitor group, floor plans or ratings. The application's GUI is projected onto a grid of 20x15 NFC-tags, providing a physical interface for touch-based interaction. Users can interact with the projected interface by touching the underlying NFC-tags with an NFC-enabled mobile device (e.g. Nokia 6131 NFC). The mobile application reads the information on the tag - its position within the grid - and sends it to the server via Bluetooth. The server maps these coordinates to the displayed interface widget and updates its presentation on the display according to the interaction. That way, users can interact with the physical interface of the NFC-display to manipulate the projected GUI of the museum guide. They can browse and download tours provided by the museum or assemble customized tours from predefined components according to personal interests.

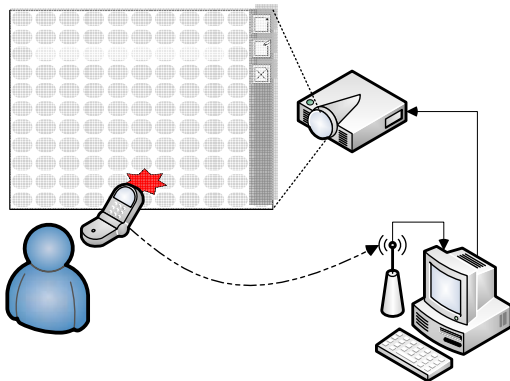


Figure 2. Overview of the dynamic NFC-display system

### 3. USER STUDY AND EVALUATION

#### 3.1 Setup and Participants

In order to assess the usability of the dynamic NFC-display and the prototype in particular, a preliminary study with 10 subjects (5 male, 5 female, average age 29) was conducted. 4 of them were students and 6 had other educational backgrounds. 8 of them have previously taken a guided museum tour and 5 have used an audio-guide. After an introduction to the interaction with the dynamic NFC-display, each subject had to perform two tasks with the prototype application: First, they had to browse a predefined tour to look up specific information about it, while for the second task, they had to compose a new tour. Each task investigated the interaction with the interfaces on the NFC-display and the mobile device. All subjects were videotaped during the study and had to assess the prototype with a questionnaire that used Likert-Scales from 1 ("completely disagree") to 5 ("completely agree").

#### 3.2 Results

The general reception of the prototype was good as a majority of the subjects would like to use it ( $m=3.9$ ). Most subjects strongly agreed that the guide would help them find their way through the museum ( $m=4.3$ ) and that it provided useful information ( $m=4.5$ ). Compared to other guides, subjects thought that the mobile guide would be a useful addition to a museum visit ( $m=4.2$ ) rather than a substitute for a guided tour ( $m=3.5$ ) or an audio guide ( $m=3.9$ ). However, subjects did not completely agree that the museum guide would help them learn more ( $m=3.3$ ).

Regarding the design and usability of the museum guide, subjects strongly agreed that it was easy to use ( $m=4.8$ ) and that they were able to carry out the tasks completely ( $m=4.5$ ) and quickly ( $m=4.4$ ). It was easy to find the information that was requested during the tasks ( $m=4.8$ ) and to recover from errors ( $m=4.6$ ). The subjects also liked the general design of the prototype ( $m=4.2$ ), including the layout of information on the NFC-display and the mobile device ( $m=4.8$ ), although some of them asked for more pictures and less text. Nevertheless, some subjects noted that the design of the interface on the NFC-display could be improved, as it was sometimes not clear which of its components were interactive. Subjects also complained that it was often not comprehensible when the focus of interaction changed from the NFC-display to the mobile device.

### 4. CONCLUSION

This paper has presented a mobile guide that uses the interaction with a dynamic NFC-display to let users explore a museum. A preliminary evaluation yielded promising results regarding the acceptance of this novel interaction technique and the usability of the prototype. The next steps in the development of the application will extend its interaction design beyond the dynamic NFC-display to include exhibits in the museum. Users could interact with them by touching attached NFC-tags with their mobile devices to get additional information, download pictures or listen to podcasts. In addition, the interaction between the dynamic NFC-display, mobile devices and interactive exhibits could be more tightly integrated. Especially the physical interface of the NFC-display could be used for collaborative interactions between multiple users, e.g. to implement learning games and quizzes for school children or to publish and share customized tours.

### 5. ACKNOWLEDGEMENT

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