Physical Affordances of Check-in Stations for Museum Exhibits

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Figure 1: Three different check-in systems to explore the physical affordances using a mobile phones (left), hand-imprint (center), and thumb-imprint (right).

TEI'14, Feb 16 – Feb 19, 2014, Munich, Germany.

Abstract
Checking in into locations has become common due to the rise of social networks such as Facebook and Foursquare. By adding gamification elements these platforms incentivize users to check-in in great numbers. Further, this function is used to create a personal history of places or a bookmark list for special locations. In this work, we investigate check-in possibilities in the museum context, where users can create such lists for exhibits. To communicate the check-in function to visitors, we develop three different concepts taking into account both the visitor's smartphone and a proprietary device in form of a wristband. We prototypically develop these concepts and explore the physical affordance of each in an initial lab study with 13 participants.

Author Keywords
Museum Guide, Affordance, RFID

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

Introduction
Memories of a visit to a museum tend to fade as soon as visitors leave the premises. Some exhibits may have left a bigger impression than others and are therefore

remembered a little longer. Just like in school, if information is not rehearsed in some way, it is doomed to fade away in our memory. To prevent this, museum shops offer a comprehensive choice of posters, books, or calendars depicting the museums' various artifacts. Naturally, these offerings are not personalized to the visitor buying them, nor to the specific route that visitors may have taken through the museum.

Hence, we investigate the mechanism of bookmarking items in the context of museums to allow visitors to collect an individual list of exhibits visited that can be taken home and reviewed post-visit. Thereby, we are inspired by applications such as Foursquare[1] or Facebook Places[2] to use check-in functions for allowing visitors to bookmark and collect museum artifacts.

To design a check-in system for exhibits, we started exploring different playful approaches to inviting visitors to check-in into an artifact. We created three prototypes designed to communicate interactivity and to invite users to perform check-ins. The term *physical affordances* [6] describes tangible design aspects of such check-in stations that can be directly linked to its action possibilities.

The contribution of this work is two-fold: (1) Exploration of affordances of a physical check-in system and (2) implementation and evaluation of 3 prototypical implementations in a museum context.

Related Work

Lindqvist et al. [5] investigate how and why people use location sharing applications such as *Foursquare* or *Facebook Places*. Amongst others their result show that check-ins are often used by people for personal tracking to see where they have been in the past. They also emphasize the gamification aspect where checking in unlocks certain badges and roles. Building on these findings we aim to create similar gamification mechanisms for museum environments where visitors can use their check-ins to collect or bookmarks specific artifacts for later review. Simon [8] comprehensively looks at audience participation in museums while considering the traditional museum model. Especially traditional museums of all types can be transformed by incorporating interactive techniques. Her work encourages us to take a closer look at how exactly interactive elements can be placed in a museum environment meanwhile communicating their function and extend clearly.

The use of RFID in a museum context has been investigated by Hsi and Fiat [3]. They augmented exhibits with RFID tags throughout the Exploratorium in San Francisco to allow visitors to interact and tag exhibits. After the visit they could re-visit those objects on a personalized website. They further report on how technology is often poorly understood by visitors and emphasize the need for more self-explanatory technology augmentation. This is where we start our exploration of intuitive user interaction with physical exhibits. Don Norman introduced the term 'affordances' into the HCI community building on previous work done by Gibson [2, 6]. Designing with affordance in mind focuses on a clear communication of action possibilities. In our work, we explore different affordances and metaphors for communicating interactive elements such as check-in stations.

[1] https://foursquare.com/
[2] https://www.facebook.com/about/location

Figure 2: The check-in box for mobile phones laser-cutted out of wood. the green LEDs visualize the check-in.

Figure 3: A wristband equipped with RFID tags.

Concept

The main goal of our work is to generate a personalized bookmark list of artifacts that can be re-visited and shared. To achieve this, we need to understand which objects visitors are interested in as well as empower users to explicitly collect these objects. In this work we are exploring different types of technologies such as NFC and RFID, but also different types of devices: we equipped a wristband with several RFID chips (cf., Figure 3) that is meant to be handed out to visitors on entry along with the museum ticket. Each wristband is allocated a unique ID which is contained on each RFID chip of that band. Another approach we implemented is making use of the visitor's smartphone. We implemented a museum guide which can be downloaded as Android app. The app uses the phone's NFC reader - if available - to read NFC tags from the museum's environment. The museum guide itself contains information about all objects of an exhibition. By checking in into an object in the museum (i.e., reading the NFC tag attached to this object), the specific item is added to the bookmark list of the museum guide and the artifact's detailed information appears on the screen.

Thus, visitors can either use their own devices to create a list of favorites or use one of our proprietary wristband prototypes. After the museum visit, this list can be used to generate a virtual tour of objects visited. Furthermore, we can use this information about collected objects to derive recommendations for related artifacts or exhibitions.

Prototypes for Physical Check-ins

Having both prototypes - wristband and Android app - at our disposal, the question now is how to encourage visitors to actually go up to artifacts and perform some sort of check-in action. Hence, we built a series of three prototypes with physical affordances meant to communicate interactivity. The prototypes (mobile phone, hand-imprint, and thumb-imprint) are depicted in Figure 1.

Mobile Phone Check-In

For direct interaction with users' smartphones we built a check-in station using the Microsoft .NET Gadgeteer[3] platform. This prototype comprises a microprocessor unit, an RFID chip, LED lights and a WLAN module. The smartphone app detects the presence of the RFID chip, reads out its ID and sends a check-in request to a server which then sends out a confirmation to the check-in station. Consequently, the LEDs on that station start flashing as to provide a visual feedback to a successful check-in action. For the hardware we built a wooden enclosure (cf., Figure 2) that is meant to invite users to slide in their smartphones.

Hand Imprint

To put the wristband to use we created two further check-in stations. The first invites the user through its shape to place her hand on top of it (cf., Figure 4). The user's right hand nicely fits onto this device made of salt paste. An underlying RFID reader scans its vicinity for the tags included in the user's wristband. As soon as the user approaches with her wristband-equipped hand, the station notifies the server and the server transfers this information to the user's profile. This profile can be accessed online or through the aforementioned Android app on the user's smartphone, which bridges the gap between wristband and artifact bookmark list.

[3] http://research.microsoft.com/en-us/projects/gadgeteer/

Figure 4: The hand-imprint used for check-in with the right hand.

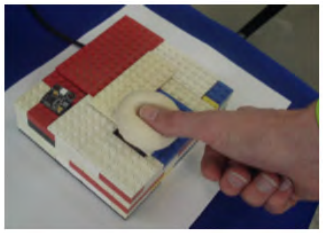

Figure 5: The thumb-imprint on a first prototype of a box containing LEDs for providing feedback.

Thumb Imprint

For the second prototype interacting with the user's wristband we created the imprint of a thumb (cf., Figure 5) rather than the imprint of a full hand. The mechanism works in the same way: by placing the thumb of the wristband-equipped hand onto the check-in station, the band's RFID tag is recognized and the object is bookmarked accordingly.

Alternatively, we placed a button underneath the thumb imprint to provide immediate feedback (visually or via audio) to the user without the need for a network communication. For allowing users to collect artifacts for their bookmark list, however, a connection to the server is required.

Evaluation

To initially evaluate user acceptance and the affordance of the three different check-in stations, we conducted a lab study with 13 participants (8 male, 5 female) between 17 and 31 years old ($M = 24.4, SD = 3.01$). After the participants arrived in the lab, we led them into a room in which we had prepared a small exhibition space containing three exhibits with one of the three check-in stations in front of each exhibit. Next, we introduced them to the museums guide and handed out a smartphone with the guide installed. After they had gotten a chance to familiarize themselves with the guide, we instructed them to interact with each station in any way they considered fit. In the end, participants filled in a questionnaire containing the System Usability Scale (SUS) assessing the system's usability. Concluding, we performed a semi-structured interview to gain insights into the affordance of the check-in stations.

Results

Investigating the usability, the system in general scores 79 out of 100 in the SUS, which is seen as a good value [1]. This shows that the prototype does in some way fulfill its function and participants are able to perform the check-ins without any major issues.

Evaluating the affordance, all participants stated that the hand imprint is the most intuitive check-in possibility. However, three participants mentioned that the hand-imprint does not work for left-handed users. One participant raised concerns regarding the hygiene especially in the museum with a lot of visitors touching the imprint each day.

All participants used the thumb imprint in the correct way, however, six participants raised concerns that not all museum visitors would understand the approach. Four participants stated that the addition of a fingerprint impression could increase the understanding.

Two participants did not understand that they should slide their smartphone into the station. They tried to stick their hands inside to check-in which did not work out. However, we believe that this is caused by the fact that participants were biased during the study because of using their hands for both other check-in approaches. Eventually, these participants liked to slide the smartphone inside the station rather than their hands due to hygienic reasons.

Naturally, these initial results are highly qualitative and need to be explored further in a long-term field study where multiple check-in stations of each type are spread out across a bigger number of exhibits.

Conclusion and Future Work

In this work, we investigated the feasibility of a physical check-in approach in a museum context by which cultural heritage artifacts can be bookmarked for later review or further exhibition recommendation. Our approach is focused on how to physically communicate check-in interactivity which is why we built a series of prototypes allowing visitors to use their smartphone or an RFID-equipped wristband to virtually collect artifacts. We are planning on deploying our system in the future in an actual museum to collect more long-term and quantitative user data. Therefore, we plan to explore a variety of different electronic platforms [4] with respect to the requirements of the museum context. Furthermore, we are interested in how the physical affordance needs to be concidered when building interactive exhibitions (e.g., [7]).

Acknowledgements

The research leading to these results has received funding from the European Union Seventh Framework Programme ([FP7/20072013]) under grant agreement no 600851.

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