CONTEXT DRIVEN CONTENT PRESENTATION FOR EXHIBITION PLACES

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Abstract

The implementation of technology driven interaction scenarios in museums faces several challenges that mainly relate to seamless integration, enhancement of user's experience, and expansion of exhibition space. After 9 related articles analyzing, 4 new interaction projects under the heading "extended exhibition" are described in this article. Advanced functional prototypes range from an interactive outdoor guide using a lamp artifact that navigates users by light intensity, to a smartphone app that allows visitors to interact with the collection of the museum and to control the presented information density. Methodological tools, the way of implementation and project findings compared to current approaches are also examined.

INTRODUCTION

For decades, museums have offered audio guides or multimedia kiosk systems to their customers to present detailed content related to single exhibits or chapters of the exhibition. Recently, media guides based on smartphone technology and bring-your-own-device approaches (BYOD) tried to extend the presentation quality of additional information about presented items, as well as multi-users' installations. While audio guides and media guides along with kiosk systems provide a potentially personalized layer of information, often detached from the exhibition and the overall experience, multimedia installations offer a more integrated approach with a high potential capacity of narrative quality. The implementation of multimedia installations, due to their integrated

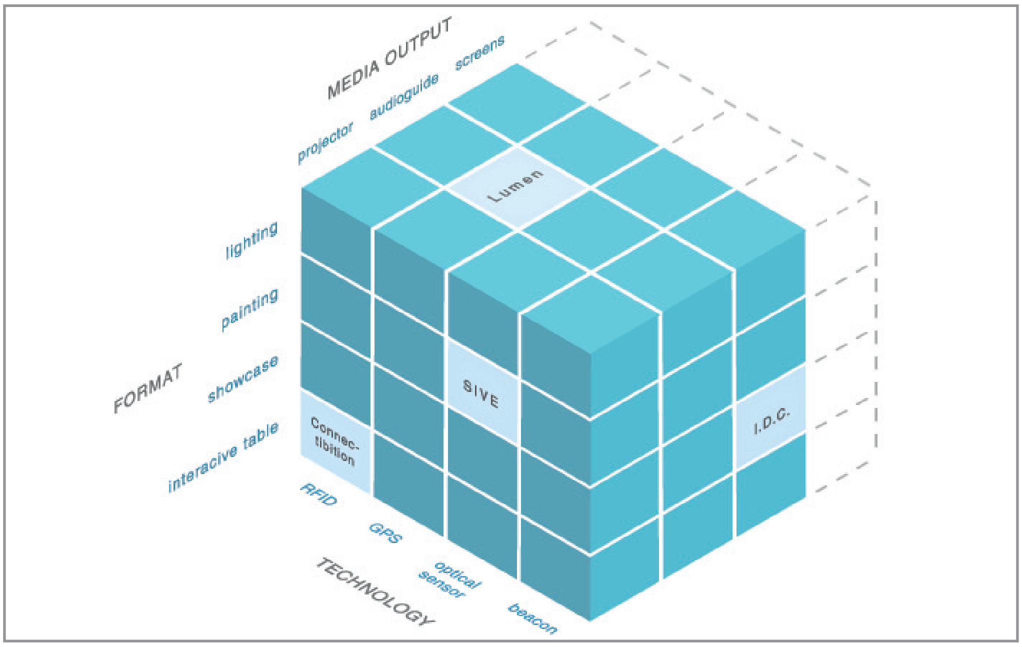

Fig. 1. 3D matrix of presentation formats, media output and positioning technologies

nature, may require custom design and engineering solutions while kiosk systems, audio and media guides can be planned and implemented successively (on system level).

The increased availability of Indoor-Positioning, using radio infrastructures like Wi-Fi, Beacons, RFID, Ultrasound or other sensor technique added with context driven machine intelligence offers new options to adapt presented media, to change the way of understanding and to interact with content and exhibits. This leads to our three design based research challenges:

1. Seamless integration into the natural exploration of an exhibition;
2. Enhancement of user's experience by means of contextual information and interaction or personalization in a narrative way;
3. Expansion of exhibition space by adding non-redundant layers of information to the existing space or opening up entirely new areas.

How could above mentioned technologies help to merge the qualities of digital content delivery media (audio / media guides / kiosk systems and customized multimedia installations), to create a user experience, which could be planned on system level as opposed to custom designed and engineered solutions?

APPROACH

Investigating into this research was the motivation for creating the setup that leads to several new interaction scenarios, applicable to the GLAM sector. In this paper we present a design based research approach (Venable, 2010 [1]) that addresses the upper research questions in four museum scenarios, developed simultaneously in one research process. These four case studies regarding the methodology of Yin, 2013 [2] were developed in a university based trans-disciplinary project "extended exhibition" [3].

The aim of this project was to produce functional prototypes to showcase interaction scenarios considering the parameters and challenges of our field of research. In order to identify possible starting points, extensive field and literature research in museums and exhibition space was conducted to create a comprehensive list of museum formats, digital output media and positioning technologies.

Then, in a collaborative effort, a 3D matrix of presentation formats, media output and positioning technologies was created to open up a roomfor possible technical combinations as carriers for interaction scenarios. In teams, in an iterative design process using an adopted variant of the "six thinking hats" method (De Bono, 1989) [4], these basic interaction scenarios were discussed, discarded or refined and extended until each team had a final concept paper as a basis for the creation of a prototype.

Each concept was inspected for necessary interaction or technological features to be evaluated by using a high-fidelity prototype, which was then built using off-the-shelf technology. The prototypes mostly consist of a functional object or installation supported by video prototypes and scenario presentations. Finally, the prototypes were presented to a wider public in an exhibition setup for the collection of pre-evaluation insights.

The demonstrated and evaluated prototypes and interaction models deal with technology driven approaches that could make the collection more accessible to the audience than current museum apps do, without compromising but strengthening curated work.

Fig. 2. Lumen prototype

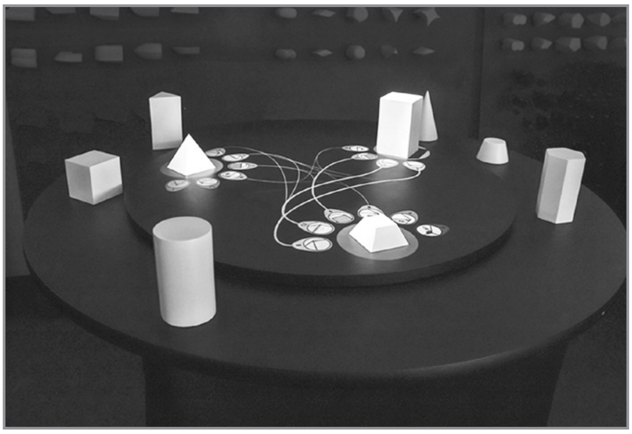

Fig. 3. Connectibition prototype

RELATED WORK

The related work mostly use locating technologies for advanced interactions with the collection of a museum or an adaptation of exhibits to the requirements of the visitors. A seamless integration of technology used was rarely taken into consideration. The table [Fig. 6] in section “Findings” summarizes the strengths of the examined work and illustrates where the developed projects can fill gaps. Using mobile devices like BYOD will be more efficient and pleasant as Tesoriero, et al., 2014 [5] wrote because just interesting exhibits will be visited. Another aspect for BYOD is the possibility of sharing content with other visitors. As Suh, et al., 2011 [6] mentioned shared content will be kept better in mind and could be used in social media campaigns. Using this technology has to be seen critically as well because it may distract and dominate the exhibition visit by the mobile device.

Rudametkin, et al., 2008 [7] focused on the experience of the exhibition. The given information, which was sent to a device, is adapted by the localization of movement of the visitor. Malerczyk, 2004 [8] used a more seamless way by visually hidden technology and controlled the interaction with gestures. Zabulis, et al., 2010 [9] showed a similar and more natural approach. The visitors’ movement was tracked by a camera, which was used to configure the exhibit. The range of information based on the time of residence of the visitor. Many concepts try to enhance the users’ experience by considering the personal characteristics of the visitors. Tesoriero, et al., 2014 [5] and Bohnert, et al., 2014 [10] use the specification of language, interests, duration of visit or handicaps to offer an efficient visit to the exhibition, guiding the visitor to exhibits corresponding to his personal profile. An exciting approach was developed by Zabulis, et al., 2010 [9]: the visitor’s interest in a specific topic is not determined by the user’s profile but by his movement pattern and resting times. Besides user’s profile S. Alletto et al., 2016 [11] consider contextual data like the number of visitors in a showroom or emotions stated by other visitors. Certain concepts pursue the objective to meet the expectations of certain target groups: Suh, et al., 2011 [6] and Confalonieri, et al., 2015 [12] address visitors in groups; Rudametkin, et al [7], Zabulis, et al., 2010 [9], Tesoriero, et al., 2014 [5] and Bohnert, et al., 2014 [10] include foreign visitors or visitors with handicaps or try to meet the demands of both experts and flaneurs. Zabulis, et al., 2010 [9] and Malerczyk, 2004 [8] take a playful approach and let visitors encounter the exhibit in a narrative context analyzing paintings or reconstructing artefacts. Zabulis, et al., 2010 [9] open a new exhibition space by presenting large scale artefacts which are not accessible to public in actual size digitally. All related works miss demonstrating interconnections among the items of the exhibition.

IMPLEMENTATION

Following the approach four interaction scenarios were developed as prototypes: Lumen is an interactive lamp, which helps users to navigate and designed city tours in a new form. A smartphone, integrated into the body of the lamp, localizes the user’s position via GPS and compares it with the coordinates of the next target. If a user moves the lamp into the direction of a target, then the lamp lights up in full brightness, controlled by an Arduino device [13]. With a greater deviation, the light is dimmed and shows the correct walking direction. At points of interest, the user gets some visualization covered by an opaque glass and audio guide for information about existing exhibits and relevant places. The user is included into exploring themes.

Connectibition is an interactive table surface for exhibitions to visualize relationships among exhibits, selected by a visitor. Vector projections illustrate the characteristics of the objects and existing relationships. Tangible objects, identified by RFID technology, can be placed on the interactive surface, whereupon the information for

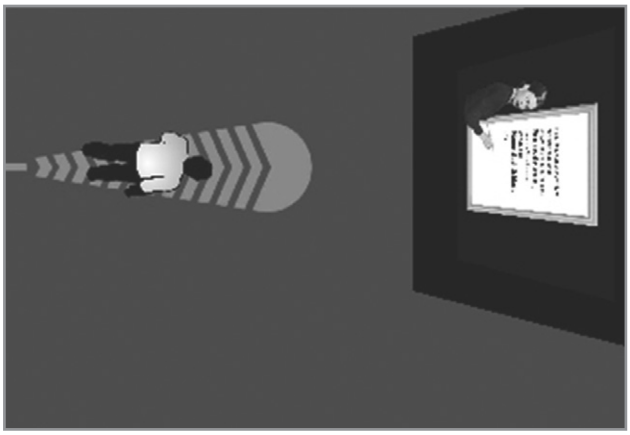

Fig. 4. SIVE interaction concept

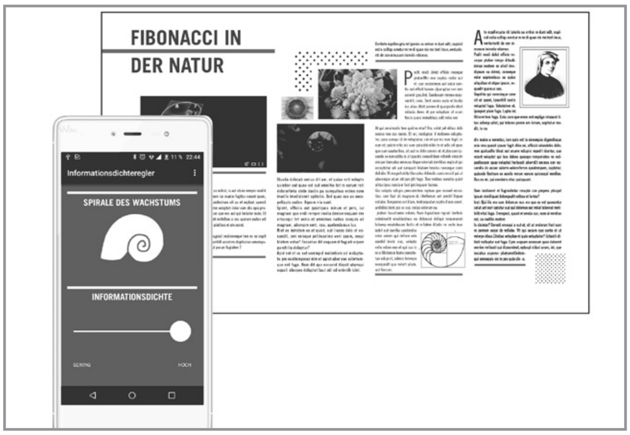

Fig. 5. I.D.C. application and exemplary display with maximal “density”

that object is visualized. If there are several objects on the surface, common features are highlighted and linked to each other. This technology may be adapted to the scope and depth of information. The concept is transferable to various subject areas.

SIVE, the sensor controlled content mediation device, is an interactive concept which can present pieces of art and artists step-by-step either on a canvas or on a screen. Visitors are guided by marks on the floor while a sensor registers their approaching. Depending on the visitor’s position, various information is presented addressing his proximity. This allows visitors to determine the depth of the information presentation by their movement. This concept ensures that attention is directed to details e.g. at a layer based presentation. To detect the distance ultrasonic detectors are used. SIVE is adjustable to the needs of an exhibition. Pictures, texts, animations, graphs, videos, lights and sounds can be varied by the visitor.

As visitors differ remarkably in previous knowledge, duration of their visit or literacy they demand an individual amount of information. Controlled volume of information prevents the visitors from being overtaxed who then react with decreasing attention. The Information Density Controller (I.D.C.) offers a user-centered impartation of knowledge in exhibitions, adopting information dynamically to visitors’ demand in amount and format, based on smartphone-technology and indoor positioning. The system – comprising of an application and exhibits with digital displays – enables visitors to manipulate the density of information for their walk through an exhibition. The visitors can regulate their individual density of information by using a slide control. An application installed on the visitor’s mobile device notices which exhibit is nearby using beacon technology. The desired information density is transferred to the digital display in the exhibition space automatically. Information of low density addresses the experience-driven visitor; information of higher density is increasingly complex and text-laden in its presentation.

FINDINGS

Lumen uses smartphone technology integrating it seamlessly into the user’s experience. By covering the display with opaque glass, using a spyhole and showing abstract visualizations only if necessary the user does not get sidetracked from the main focus. Therefore, he can act naturally as required by Zabulis, et al., 2010 [9] nevertheless using the entire range of smartphone functionality. Because of its self-explorative character Lumen enables the user to learn more efficiently as pointed out by Tesoriero, et al., 2014 [5]. Users learn based on experience about abstract content what makes the learning outcome more sustainable. Navigation is a fundamental aspect of Lumen. Location is determined by the GPS of the smartphone and the compass function allows navigation support via light brightness To guide the user securely an additional voice instruction will be spoken on long pathways. It strengthens the exploratory character, mentioned in Tesoriero, et al., 2014 [5]. Based on a storytelling approach Lumen enhances user experience and addresses new target groups: Focusing on group experience (Confalonieri, et al., 2015) [12] the content addresses groups of visitors in particular. Collective exploration strengthen the bonds and intensifies memory.

Without requiring any showroom to guide users, Lumen expands the exhibition space. GPS positioning and compass functions are provided by the smartphone device and controlled by an Arduino board. A high-performance LED is used for navigational hints and illuminates the desstinationwhen reached. In this way exhibits can be presented and do not need digitization as stated byZabulis, et al., 2010 [9]. Two conditions must be fulfilled for a usage: a) an acceptable route without barriers to avoid accidents. b) effectual darkness for navigational support with a light beam. There are plenty of new items that can be explored outside the showroom: statues, parks, original locales at historical places, (destroyed) buildings, etc.

In spite of a high of technical elements at connectibition, the visualization of relations and haptic elements of the exhibit are most dominant, asMalerczyk 2004 [8] and Zabulis, et al., 2010 [9] stated. The technique is seamlessly integrated and not visually perceived by visitors. Connectibition allows direct interaction with the exhibit by using objects as tangible interfaces. Rearranging the objects in different ways the visitor can explore interconnections and differences among certain exhibits. By combining objects of interest he can find out more about them. Malerczyk 2004 [8] uses a similar way to show more details of the aspect a visitor is interested in. This personalization of interests and the experiential learning enhances the user's experience. The exhibit can be configured by individuals and groups. The common interaction supports the ability of personal retrospection, as Suh, et al. 2011 [6] showed.

Similar to Malerczyk, 2004 SIVE works without any haptic controls and offers the visitor an intuitive access by the deviceless control [8]. The natural behavior of approaching an object in curiosity leads to further information. By interaction with visitors paintings can be expanded and modified in appearance depending on the distance (Zabulis, et al., 2010) [9]. The interest-based details can present different working states or special views of the paintings considered, which are normally hidden (Malerczyk, 2004; Zabulis, et al., 2010) [8,9]. Furthermore, it is possible to establish relationships amongst exhibits and to offer an interactive story. Besides the new presentation of content, the localization-based system can achieve new places and reach more audiences. Since the interaction has taken place without any additional tools, classical museum collection can be presentedto the public in atypical locations (Tesoriero, et al., 2014; Zabulis, et al., 2010) [5,9].

Taking into account the approaching era of ubiquitous computing the I.D.C. integrates mobile devices seamlessly into the visitor's museum experience by using bluetooth technology. Alletto et al., 2016 [11] provide a good basis for the concept of interaction of the I.D.C. In an exhibition the I.D.C. disappears from visitor's perception. Whereas other systems require the use of mobile devices during the visit or suspend visitors without any mobile device (Tesoriero, et al., 2014, Bohnert, et al., 2014) [5, 10] the I.D.C. demands a one-time setting and offers a standard view with average density of information to any visitor without a mobile device. Information is displayed on and about the exhibit. Adoption of information shown on the screen of a mobile device (Tesoriero, et al., 2014) [5] affects the visitor's exhibition experience, which the I.D.C. neither wants to cut nor to disrupt by navigational instructions. The personal information density does not only affect a single exhibit (Zabulis, et al., 2010) [9] but every digital display. In case of aroused interest or decreasing attention visitors need to adjust to the density of information. Zabulis, et al., 2010 [9] and Rudametkin, et al., 2008 [7] link the amount of displayed information to motion patterns or users' profiles, which do not allow targeted adjustments. The slider being the essential control element of the I.D.C. application offers an intuitive interaction using a simple metaphor with immediate feedback. I.D.C. is based on visitors who differ considerably in previous knowledge and literacyand should not be confronted with same density of information to avoid overload and frustration. Museums should reach out for the visitors' level of knowledge and experience. Whereas Tesoriero, et al., 2014 [5] and Rudametkin, et al., 2008 [7] consider language, physical handicaps and personal interests as a personalization of information, I.D.C. dynamically adopts information not only in amount and complexity, but also in approach. Displayed information of low density addresses experience-driven visitors (children, short-time-visitors) working with (moving) images. By selecting the setting high density increasingly nous-driven and text heavy types of information are built upon to address visitors with extensive knowledge and excellent literacy (experts). Whereas Bohnert, et al., 2014 [10] prioritizes certain topics and Rudametkin, et al., 2008 [7] filter exhibits using personalization - creating a sort of filter bubble - I.D.C. does not hold back any information. According to Zabulis, et al., 2010 [9] the visitor decides what exhibits he is interested in when strolling through the exhibition. This kind of visit allows "informal learning".

CONCLUSION

The iterative design process followed by the prototyping phase produces four demonstrators which are able to show the potential of the proposed interaction scenarios. The whole design process profits from the close cooperation of design and engineering professionals in both phases as design and technology were developed interdependently. Thus, functionality of the prototype could be assumed. While all prototypes demonstrate the look and feel of the proposed interaction scenarios, there still needs to be considerable thought put into aspects of technical scalability as well as into economic exploitation. Problems might occur when it comes to managing content or producing and maintaining lots of dedicated hardware units or apps across several platforms. The user's experience related challenge of accessibility also was not thoroughly considered in this stage of the project.

For all delivered prototypes the potential of creating user's experiences by positioning technologies was evaluated in field tests, either tracking the visitor or the exhibit. Existing exhibits or their replicas can be used as access to meta information (connectibition), the visitor can physically change explanatory perspectives towards an exhibit (SIVE), adjust to the information layer of a whole exhibition space, to his own pace of exploration, or whole new exhibition spaces can be created by the use of a narrative, guiding object (Lumen).

Apart from narrative interfaces enhancing the user's experience, tracking mechanisms and mobile devices could be used to increase accessibility to the exhibition and target specific visitor groups by language and thematically focused meta-information. As stated by Bohnert, et

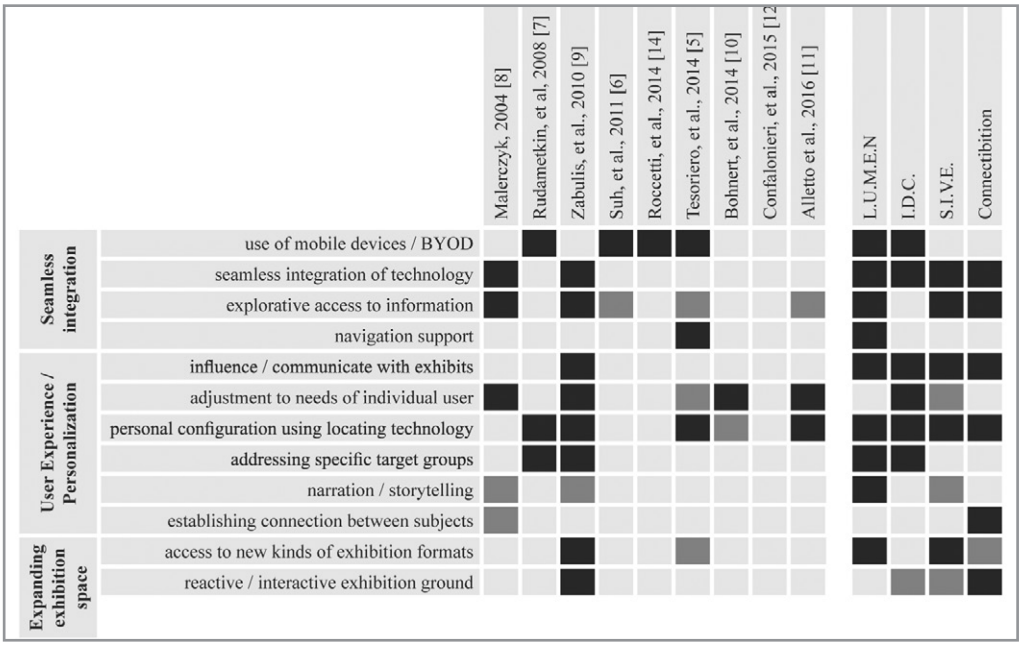

Fig. 6. Related work and developed projects compared to research questions

al., 2014 [10], at the same time gathering data about visitors' behavior could lead to valuable insights of the reception of exhibitions providing hints for improvement of content and presentation.

Analyzing the strengths of other work in this field – as shown in table 1 [Fig. 6] – compared to the projects presented here, a significant higher effect of seamless integration, user's experience/personalization, and expanding exhibition space could be demonstrated.

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Our four museum interaction scenarios are documented and enhanced with additional footage that lively shows the interaction on medium.com [3].

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