

InfoGrid: An Approach for Curators to Digitally Enrich their Exhibitions

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Abstract

In this contribution, we present our research on applications for curators to digitally enrich their exhibition. One of the applications we developed is the Augmented Reality (AR) app called InfoGrid. The app consists of two components: first, museum professionals can use InfoGrid to augment physical exhibitions with digital content through the web-based content management platform, the ALS-Portal; second, visitors use InfoGrid on their own mobile devices to experience these digital augmentations of exhibits via AR. InfoGrid, as well as the ALS-Portal, interface with our backend system, the Network Environment for Multimedia Objects (NEMO). The NEMO framework provides ALS applications with their application logic, semantic models, and functions as the semantic data storage. Museum professionals can use ALS software to automatically process image or video footage to create 3D objects, which can be aligned and cleaned from artifacts in the ALS-Portal by the help of our web-based 3D object editor. ALS software also contains a web-based video editor, which enables curators to create and edit video files, which can be used in all ALS applications. Through the ALS-Portal, museum professionals can look into usage statistics to improve their exhibitions. We present a field setup of an exhibition of original paintings, sculptures and literature created by Günter Grass, the German Noble Prize winner for literature. The exhibition took place in the “Bremische Bürgerschaft” in the Hanseatic City of Bremen over a period of seven weeks.

1 Introduction

In the past, museums had to collect, store and selectively display their collections as physical objects. With advances in technology, museums are faced with new challenges. They meanwhile work on the presentation of mixed physical and digital exhibits from their collections to fit the needs and interests of their target audience. Additionally, the museum is viewed and used more and more as an advertising platform for brands and franchising, a leisure machine, an interim storage facility for collectors, a symbol of prosperity and a connection to the world economy (Dirgantoro, Joseph, & Martinez, 2016).

In our research project *Ambient Learning Spaces (ALS)*, we address some of these challenges. For more than 10 years, the *Institute for Multimedia and Interactive Systems (IMIS)* at the University of Luebeck develops digitally enriched environments for schools and museums in

a research project mainly funded by the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG). In the context of the ALS project, body- and space-related human-computer interaction supporting cross-device interaction (XDI) are the main conceptual foundations for this research. The Museum for Nature and Environment and the Günter-Grass Haus, both located in Luebeck, Germany, are our project partners.

2 Scenario

In the following section, we present a scenario, which focuses on how a curator prepares a digital tour inside the exhibition with InfoGrid.

2.1 Curators' View

The museum curator Sonja Reimers decides to set up a digital tour for her Günter Grass exhibition. To do so, she uses her laptop and brings together a list of the names of the exhibits already placed, which she wants to enrich digitally. She adds typical photos of the exhibits from her repository

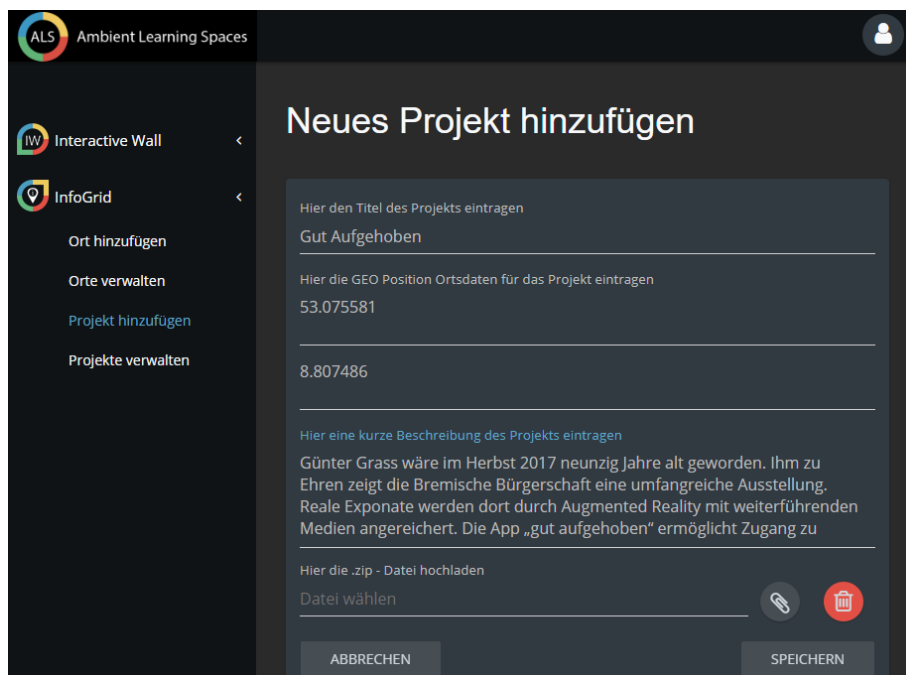


Figure 1: Screenshot of the InfoGrid tour creation dialogue inside the ALS-Portal.

Afterwards, she logs into the ALS-Portal with her user credentials and selects from the menu to create a new digital tour. Then she enters “Gut Aufgehoben” as the name of the tour, adds

a description and the geographical position of the exhibition site into the ALS-Portal (see Figure 1). In the next step, she uploads a set of markers into the ALS-Portal. After entering the information, she chooses the type of augmentation she likes to setup for this exhibit. The options are text, image, audio, video, and 3D object. She selects *audio* and uploads a recorded MP3 file of Günter Grass reading a poem. She repeats this process with different media for all objects she wants to augment (see Figure 2).

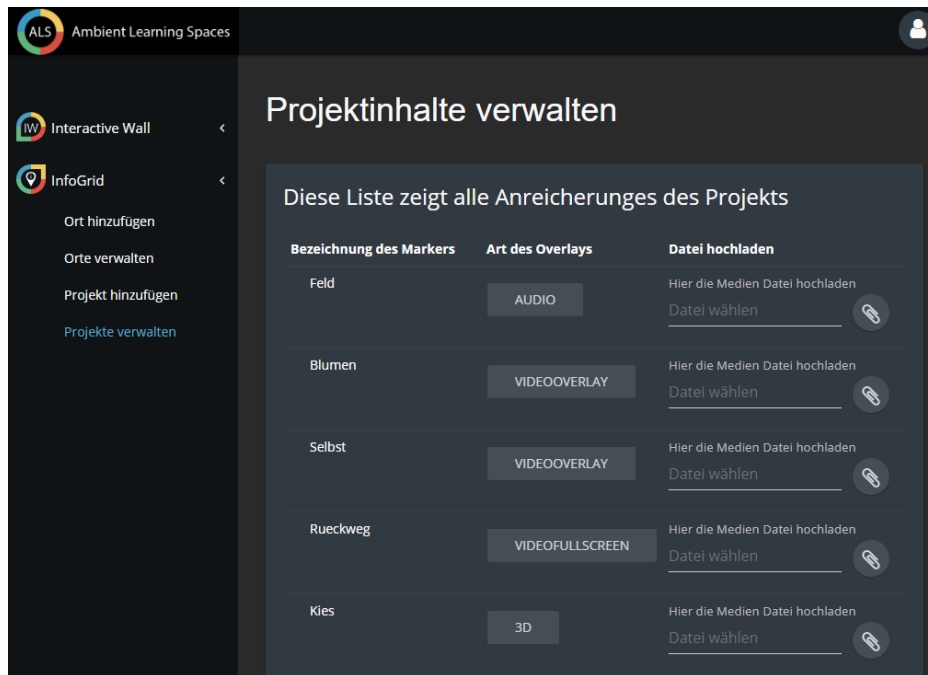


Figure 2: Screenshot of the InfoGrid project creation dialogue inside the ALS-Portal

Afterwards, she puts her laptop aside and logs into the InfoGrid app through a tablet with her user credentials. Using her personal account, she automatically gets access to the curator's view of the app, which shows a list of all her published and unpublished digital tours created so far. Sonja selects the newly added tour "Gut Aufgehoben" and walks to the first exhibit. Then she directs her tablet into the direction of the object and sees an audio playback button augmented over the exhibit on the screen of her tablet. She notices that the button is not very well placed and uses the corresponding function to move the playback button to the appropriate display area. Then she walks to the next exhibit. When she points her smartphone towards the artwork, the app shows a 3D object of a book, which she uploaded earlier into the ALS-Portal. The object shows up with a size too small with a wrong orientation. To fix this issue, Sonja selects the zooming function of the app to rescale the 3D object and afterwards uses the rotation function to correct the orientation. Sonja continues to put all augmentations perfectly into place and saves the changes. A first version of the new tour is now ready for use by visitors.

3 Related Work

Enabling museum curators to create and edit their digital content is a current field of research. The need of advanced technical skills or knowledge creates major barriers that prevent non-expert users from building cross-reality environments. Developing specialized toolkits or frameworks for curators can help them to quickly setup cross-reality environments (Bellucci et al., 2017). Another way to support curators in learning to use the tools necessary to create or edit digital content in their exhibition is by providing them with visual and written scenarios. Although this is not completely sufficient, it still poses a useful resource (Maye et al., 2017).

The evaluation of visitor interaction inside exhibitions is an intensively field of research. For our development and evaluation, user interactions with exhibits are of most interest. To understand visitors' interests, curators can use and analyze tracked data from the visitors' movement behavior inside the exhibition (Lanir et al., 2016; Sparacino, 2002). Many timing and tracking studies have been conducted since the 1990s and today they are routinely included as a necessary part of understanding and measuring the success of an exhibition (Yalowitz & Bronnenkant, 2009). Furthermore, visitors' behavior patterns can be predicted to some extent, even if there is only little information about the individual visitor (Kuflik, Boger, & Zancanaro, 2012).

4 ALS Applications

For museum professionals, we provide a specific subset of the ALS-Portal's functionality, which allows adding digital content to exhibitions and on content creation. If museum professionals want to add content for InfoGrid, we currently provide a set of input screens, where media files can be uploaded and assigned to specific markers, so the visitors can see them through the app. Inside the ALS-Portal we plan to introduce individualization forms which allow the curator to publish contents in multiple languages and for different age groups or special interest of the visitors. This individualization is implemented using additional digital properties for the media. The app itself recognizes users through an authentication feature. We already provide an input form for content, which shall be displayed on large public displays in form of a timeline. We currently work on a function, which individualizes the content displayed on large public displays based on, e.g. visitors' usage statistics of InfoGrid inside the exhibition. Another area of our research is the creation of automatically individualized narrative tours, which can be created through definition of additional tags as semantic annotations for each uploaded media file.

For the curator, we developed a set of ALS tools to streamline the process of AR content creation and content placement. We implemented an automatic generation of 3D models through NEMO (Bouck-Standen et al., 2018). This is achieved by a component, which automatically processes image or video footage to create 3D objects. These 3D objects can be aligned and cleaned from artifacts in the ALS-Portal with the help of our web-based 3D object editor (Bouck-Standen et al., 2018). The 3D objects created and semantically annotated can be

used by the museum professionals in their exhibitions. We furthermore developed a video editor for creating and editing video files. This editor can mainly be used to edit videos, create video footage from images, and to add audio tracks. These web-based tools we developed are available for museum professionals through the ALS-Portal. Once a 3D object has been assigned to an exhibit, it will be available in our curator's mode in the InfoGrid smartphone app, which allows museum professionals to rotate, resize, and translate the object inside the exhibition for perfect placement.

5 Setting in the Bremische Bürgerschaft

In our field setting in the house of the Bremische Bürgerschaft, we set up InfoGrid in connection with our backend system NEMO. Through InfoGrid, we have already gathered qualitative feedback, e.g. during the Night of Museums in 2017 in Luebeck (Ohlei et al., 2017). The goal is to collect statistical data on user interactions during the autonomous and unguided use of our systems.



Figure 1: Left: Screenshot of InfoGrid displaying the reconstructed 3D model of the figure “Der Butt” of Günter Grass. Right: Three artworks of Günter Grass presented in the Bremische Bürgerschaft. We marked two artworks with icons to indicate that the visitors can use InfoGrid to scan and interact with the artwork.

The setting in the Bremische Bürgerschaft was based on the physical exhibition curated by the Günter and Ute Grass Foundation in celebration of the 90th birthday of Günter Grass on October 16th, 2017. On three publicly accessible levels of the house the curator of the Bremische Bürgerschaft placed mostly artworks (see Figure 1). From 72 exhibits in total, we augmented 23 exhibits with different media types. We used 6 written poems as texts, 7 images, 5 audio recordings, 3 video files, and 2 digital 3D objects. We created a 3D object of “Der Butt” using photos of the real physical sculpture, which belongs to the Günter Grass-Haus. In the foyer next to the entrance we placed a poster showing instructions on how to download InfoGrid using a Wi-Fi hotspot available inside the entrance area. The app cached all media files on the device, because a Wi-Fi connection was not available inside the exhibition area. The app including all media files was about 100 MB in size. Next to each exhibit, which the visitors could scan with InfoGrid, we placed an icon as a hint to help the visitors recognize, on which exhibit to expect digital content through photographic markers. For the exhibition, the curator supplied

the digital content for InfoGrid. We collected statistical data regarding downloads and application starts from the corresponding application stores. InfoGrid itself collected data on usage and user interactions, which were submitted to the NEMO server.

6 Results and Discussion

In the exhibition in the Bremische Bürgerschaft we augmented 23 of 72 physical exhibits with audio files, poems in text form, images, videos and 3D objects through our augmented reality app InfoGrid. The recorded audio files contained poems read by Günter Grass. The augmented media mostly came from the same books as the physical artworks. Therefore, they were closely related. The visitors could enjoy the artwork spread over three floors of the building. We marked each exhibit, which offered an augmentation to the visitors, with an icon next to it.

ID	Type	RE	Median	Min	Max
23	3D 2	23	7,88	0,37	80,80
1	Audio 1	16	18,68	7,54	40,16
12	Image 1	16	15,19	1,03	40,23
21	Video 3	15	33,52	2,05	56,42
5	Audio 5	14	19,42	0,60	50,33
9	Text 4	14	9,79	1,12	35,44
3	Audio 3	13	18,57	0,68	47,65
19	Video 1	13	6,06	1,63	59,49
2	Audio 2	12	11,42	2,23	57,89
22	3D 1	12	13,12	1,73	50,81
4	Audio 4	11	26,36	1,17	48,96
8	Text 3	11	14,33	1,50	58,30
6	Text 1	10	6,47	0,85	37,14
11	Text 6	10	15,04	1,03	45,49
15	Image 4	10	10,00	1,43	26,42
7	Text 2	9	21,38	1,30	57,25
10	Text 5	9	14,89	1,71	52,93
16	Image 5	9	16,75	1,67	24,62
20	Video 2	9	26,07	1,37	38,78
14	Image 3	8	10,95	1,23	57,05
13	Image 2	7	4,37	1,28	17,80
18	Image 7	4	23,60	10,68	40,75
17	Image 6	3	20,05	5,47	41,64

Abbreviations:

ID, ID of the marker; RE, number of recognitions of the marker

Table 1. This table presents the amount of recognitions of the markers in the exhibition. The Median, Min and Max represents the time in seconds each visitor interacted with the marker using his or her mobile device. We excluded visitors that did not interact with the marker from the calculation.

There were 32 app installs in total (13 Android and 19 iOS installs) over a period of seven weeks. We noticed that with just a poster and some information on the webpage of the Bremische Bürgerschaft as announcement for the AR installation, most visitors did not notice the availability of the AR installation. Since the setting in the Bremische Bürgerschaft was open and free of charge, there was nobody like at a cashier, who could inform the visitors about the availability of the app right in the beginning of the visit. During the exhibition, we counted 41 anonymous app usages, excluding our own tests, with a total of 258 requested augmentations. For each user session, InfoGrid augmented a mean of 6.62 (± 6.12 SD) exhibits. The download statistics show that it is reasonable to offer an Android as well as an iOS version of the app. In our results, we compared the number of downloads with the amount of app usages. It has shown that 9 app starts were repeated usages by users who used the app before. This information is derived from the download statistics (32 app installs) and the app usages (41).

The log statistics of Table 1 indicate that the physical location of an artwork is important so that the visitor can notice it. Introductory objects in entrance areas are selected quite often and can therefore serve as motivating starting points, if they are attractive and allow successful interaction. We placed the marker for “Der Butt” right under the information poster informing about the app in the entrance area. For future development, it seems helpful to build a digital floor plan of the exhibition and draw visitors’ paths or heat maps, as proposed by Lanir et al. [14] through the museum to investigate visitors’ movement and interaction patterns to support the decisions of the curators. Artworks with a low number of recognitions were mostly located in more secluded areas. Therefore, it might generally be helpful to guide the visitors to these secluded locations explicitly along a narrative storyline. Curators may check whether changes in their exhibition successfully promote these more challenging areas. Through the user comments feature of the Android store, a user reported that he would have liked to use the app at home after the event.

7 Conclusion

In this paper, we present our research on ALS applications, which can be used by curators to digitally enrich their exhibition. We introduce InfoGrid which can be used to display the information that curators entered into our backend framework NEMO through the ALS-Portal. We also introduce parts of the ALS-Portal allowing museum professionals to create, add, and edit content for their digital exhibitions. We also evaluated the mobile AR app InfoGrid in an exhibition of Günter-Grass’ artworks in a real field setting. It shows that visitors are successfully using the various media enrichments of physical exhibits. Log data collected by NEMO can be used by curators to track and evaluate the visit of exhibits and the effective use of media. The setup gave us important information on how to improve the system for curators to optimize the layout of an exhibition for best perception of exhibits presented. The findings can be used for many other exhibitions with a high level of digital enrichments of artifacts as well. The ALS architecture itself can be seen as a blueprint of a future architecture for museums and other public educational systems, based on semantic modeling of the digitally enhanced physical objects giving many options for knowledge-based interactivity like narratives or individualized exhibits.

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