"Digital Threads across the Landscape" – a smartphone application co-developed by users

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Zusammenfassung – "Digital Threads across the Landscape" ist eine Smartphone-Anwendung, die prähistorische und historische Funde und Fundplätze passend je nach dem aktuellem Standort des Benutzers anzeigt. Das Projekt strebt an, das kulturelle Erbe für ein breites Publikum leichter verfügbar zu machen und die Öffentlichkeit auf neuen und anderen Wegen für die Kulturgeschichte zu interessieren. Es soll dem Publikum neue Erfahrungen außerhalb der Sphäre traditioneller Museen vermitteln mit Hilfe standortbezogener Programme in Smartphones und Techniken der "Augmented Reality". Derzeit sind 51 Orte, die eine Zeitspanne von 12.000 Jahren abdecken, in einer App verfügbar. Ein web-basierter Editor macht es z. B. für Museumskuratoren einfach, neue Orte selbst hinzuzufügen, so dass die Anwendung derzeit von Monat zu Monat wächst.
Während des Entwicklungsprozesses wurden zwei Gruppen von Nicht-Profis als Mitentwickler hinzugezogen: eine Gruppe von Studenten und eine Gruppe von Senioren. Die Beteiligung von zwei sehr unterschiedlichen Zielgruppen war fruchtbar und lehrreich für alle Beteiligten. Die Entwickler und die Museumskuratoren erhielten neue Ideen und direkte Rückmeldungen seitens des Publikums zur Form, Funktionalität und zum Inhalt des Projekts. Umgekehrt entwickelten die beteiligten Nicht-Profis ein Wir-Gewühl und wurden zu Botschaftern der entwickelten App.

Schlüsselwörter – Smartphone App, Kulturgeschichte, neue Museumserlebnisse, standortbezogene Techniken, Erweiterte Realität, partizipatorisches Design

Abstract – "Digital Threads across the Landscape" is a smartphone application designed to display prehistoric and historic finds and sites at the actual locations where events took place. The aim of the project is to make cultural heritage more readily available to a wider audience and to engage the public with cultural history in new and different ways; creating new experiences outside of traditional museum settings by means of location-based mobile phone software and Augmented Reality. Currently 51 locations, spanning 12,000 years of cultural history, are available through the app. A web-based editor tool makes it easy for museum curators to add new locations and more sites are being added every month.
Throughout the design process two groups of non-professionals have been involved as co-creators; a group of students and a group of seniors. Engaging two, different target groups proved fruitful and educational for everyone involved. Not only did designers and curators get fresh ideas and immediate response on form, functionality and content, it also caused the co-creators to take ownership and act as ambassadors for the app.

Key words – smartphone app, cultural history, new museum experiences, location-based technology, Augmented Reality, participatory design

Idea and concept

In traditional museum exhibits artifacts and objects are displayed far away from the locations from where they were retrieved. Thus, the artifacts and stories behind them are physically detached from the locations where events actually took place. Often, no traces are left at the sites themselves, making them invisible in the present landscape. The same holds true for many historic buildings. For example, in Herning, a city whose identity was formed based on the textile industry, many of the buildings that played an important part in this industry are either gone or have been repurposed for other uses. Since it is neither possible nor desirable to install signage at every relevant location, one can easily walk by them without ever knowing all of the "invisible" stories. One of the main ideas behind "Digital Threads across the Landscape" was to incorporate all these locations of past events, providing a different paradigm for understanding and experiencing the past (**figure 1**).

As a means of communication, the smartphone application is a dynamic extension of the current options for on-site communication (Bolter & Grusin 2000), which typically consists of signboards and leaflets (for a limited number of noteworthy sites). The internet and the possibilities provided by mobile devices have changed our way of communicating and the manner in which we appropriate information. By introducing an app, the museum experience is no longer bound to the physical museum space during opening hours. Information can now be accessed anywhere, at any hour. Moreover, in utilizing location-based technology and Augmented Reality a completely new dimension is added to the traditional exhibition experience (Hainich 2009; Kraub & Bogen 2010; Lemmens, 2010), operating in the field of mixed reality (Milgram & Kishino 1994). The exact locations of past events can be visualized, and these provide a physical context for the objects and stories we wish to communicate. Thus, these "invisible" sites and stories are made visible in the city- and landscape surrounding us.

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Fig. 1 "Digital Threads across the Landscape" (Digitale Traade over Landskabet) is free and available through the App Store and Google Play. Danish language only. ©The Alexandra Institute.

Fig. 2 An overview of the basic structure of the contents. ©The Alexandra Institute.

The idea behind "Digital Threads across the Landscape" is to make our common cultural heritage more visible and readily available to a wider audience[1]. It is one of the first smartphone applications communicating cultural heritage, especially archaeology, to the general public using Augmented Reality. The application applies Augmented Reality to archaeological (and historical) locations where no physical remains are visible. An extra dimension is added in the form of interactive features that are only activated on-site. One of the aims of the project is for people to visit the sites and experience cultural history on location and so, perhaps, to be inspired to visit a museum to learn more. This new means of communication was also chosen in order to entice new target groups who rarely visit museums. In order to develop a product attractive to the general public, two groups of potential users were invited to participate in the design process: students and seniors. In a Danish museum context this is the first time non-professionals have been involved in every step of the design process creating a cultural history application for smartphones.

Functionality

"Digital Threads across the Landscape" is designed to reveal prehistoric and historic sites on location by utilizing location-based mobile phone software (GPS) and Augmented Reality (AR). From the main menu, an overview of accessible locations can be displayed in three different ways: as pin-points on a map, as a digital layer seen through the phone's camera or as a list. A filter can

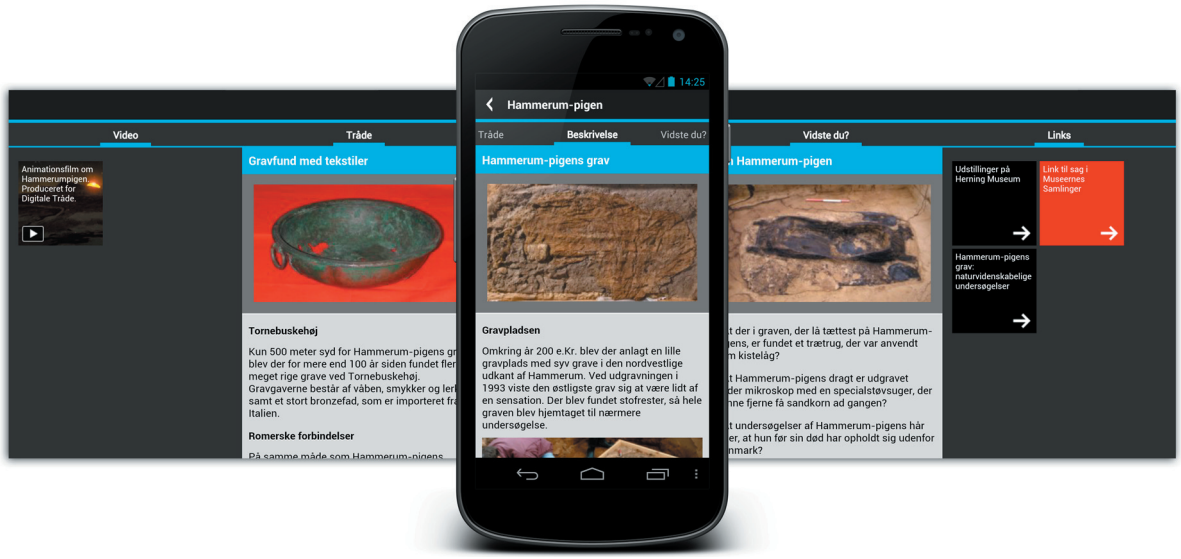

Fig. 3 Panning the phone across the landscape, a digital layer is superimposed on top of the camera image when hitting the exact site location. Photographer: Jonas Helt. © Museum Midtjylland, DK.

Fig. 4 Reconstruction of an 11,000 year old Stone Age site. By tapping various elements you can learn more about the objects found and see photographs from excavation. Artist: Sune Elskær..

Fig. 5 A group of co-creators are testing and discussing an early version of the app in January 2012. Photographer: Kitt Boding-Jensen. © Museum Midtjylland, DK.

be applied in order to show locations close to you and/or locations dating to a specific time period of interest. In order to access information, you simply tap on the location you want to explore. The basic structure of content consists of three sections where pictures are intermixed with text and a section with relevant links to the internet (**figure 2**). Some locations also have short videos or sound files attached. This part of the app is conveniently accessible from home or anywhere else the public desires. But in order to inspire people to go and experience culture history on location, parts of the app are only active when on site (**figure 3**). Panning the phone's camera across the landscape or a building, the specific location is revealed as a digital layer projected over the modern background. For archaeological sites, this can be in the form of a reconstruction (interpretation) of what a site or feature may have looked like in the past, an excavation plan, or a photograph (**figure 4**). For historic sites, it can be an old photograph or drawing projected on top of a present day building. These images are interactive in the sense that various elements can be further explored by tapping on them directly on the screen. Thus, it becomes possible to get an impression of what went on and experience the past at the precise locations where events took place. Instead of being a passive spectator, the users have the opportunity to participate and explore based on their own specific interests and guided by curiosity.

Currently 51 locations, from archaeological sites to medieval churches to more recent historic buildings, are available through the app, and more locations are being added every month. An online, web-based editor tool makes it easy for museum curators to add new locations and make changes to existing ones, an important consideration when designing the app. With this current solution we can add sites and modify content in-house, without a constant need for technical support. In this way, we have ended up with a very dynamic app with fluid content, as opposed to a fixed product with static information.

Design process

An interdisciplinary team of professionals, consisting of museum curators (Museum Midtjylland, DK) and computer scientists and designers (the Alexandra Institute), was responsible for the overall design. The general idea was to develop an app that would attract a new group of users, young people, who do not often visit the museum on their own account (Kobbernagel, Schrøder & Drotner 2011). At the same time, we also wished to end up with a platform that would be interesting for our current museum clientele, who are primarily seniors over the age of 60. In order to gain insights into these potential users' wishes and expectations for this new means of communication, we invited two groups of non-professionals to participate in the design process.

One group consisted of six students, aged 18 to 22, none of whom had visited the museum before or had any particular interest of cultural history. On the other hand, they were very knowledgeable about the world of smartphones and apps, this technology being an integrated part of their daily lives. The other group consisted of five seniors, aged 60 to 75, who are dedicated museum volunteers. They are interested and fairly knowledgeable about the finds and exhibits at the museum as well as the cultural history of the local area, but not at all familiar with smartphones.[2]

The two groups committed to participate in a total of four workshops, each session set to last for three hours. The workshops took place at the museum with some additional testing outdoors on site. Three workshops were carried out as parallel sessions in separate groups and one workshop was carried out as a joint session with both groups participating. The mode of parallel sessions was chosen in order to compare the process and the ideas generated between groups as well as to identify special interests and requests relevant for the individual target groups. The joint workshop was actually the idea of the participants themselves, since they were very curious to

Fig. 6 What is this? The students were presented with a close up photograph of Stone Age chewing gum. Photographer: Søren Timm Christensen. © Museum Midtjylland, DK.

meet and work together. After each workshop, the output was analyzed and discussed by the professional design team and incorporated in the next step of development.

Users as co-creators

The workshops were apportioned across the entire project period spanning the stages of preliminary analyses, development, testing and evaluation.[3] Brandt and Eriksen (2010, 71) differentiate between users as evaluators and users as co-developers:

"They [users] can be involved in two different ways. They can be invited to test or comment on proposals made by the core design team, or they can be brought in as co-designers taking active parts in developing and exploring possible futures".

In this project the users were involved as co-designers or co-creators (Simon 2010), since they not only evaluated the app, but were actually involved in the creation of content and form (**figure 5**).

Since we were not able to offer a salary for their efforts (although there was a draw among the students to win a smartphone), it was important that the co-creators gained from the process in other ways (e.g. experience with cultural history and new technology). It was equally important to make sure that they could see that the project gained from their involvement and grew due to their input and ideas. Therefore, every workshop started with a summation of what was achieved during the previous session and how these ideas had been implemented in the development of the app. Thus, the co-creators could watch the app develop based on their participation. This does not mean that all ideas were used uncritically, but it was possible for the professional design team to adjust the app in terms of form as well as content during the process of development. Additionally, the participants' engagement in the design process created a sense of ownership which made them good ambassadors for the project. Both students and seniors actually acted as guides when the app was officially launched.

Fig. 7 The seniors recognized this object, the complex hairdo of the Hammerum Girl. Photographer: Roberto Fortuna © Museum Midtjylland, DK.

Workshop 01

The first workshop was focused on content and identifying intriguing stories. The student group was presented with a highly enlarged photograph of an artifact completely unknown to them: a small piece of 10,000 year old birch pitch with tooth marks – Stone Age chewing gum (**figure 6**). The senior group was presented with a photograph showing the hairdo of the Hammerum girl – an extraordinary Iron Age grave and one of the highlights of the museum exhibit – a find which they immediately recognized (**figure 7**). In giving the students an object unfamiliar to them, the idea was to arouse curiosity and let their imaginations run wild. Providing the seniors with a familiar starting point, the idea was to challenge their knowledge about the find – what did they already know and what else would they like to know? – but also to make them feel confident about the project (smartphones and apps being something very exotic).

The task for both groups was to study the photograph in silence for 20 minutes, while writing down all the questions, ideas and feelings

relating to the objects in question. They were then asked to discuss the objects as a group and pose their questions to two museum curators, who were carefully instructed to answer questions only and not elaborate or provide additional information. This was done in order to leave the participants in charge of identifying the topics of interest – not the professionals (who might have completely different ideas about the interesting stories concerning the objects). Finally, the participants were asked to write down the three most important questions relating to the object. It was interesting to note that while the students talked from their own point of view and posed questions they themselves would like to have answered, the seniors were more concerned about what would be of interest to others. This may be due to the fact that the seniors, unconsciously, tried to act as facilitators in the design process because they were already familiar with the object in question. Overall, in spite of differences in prior knowledge about the objects as well as between the objects themselves, the groups ended up with very similar questions: how old is it? how do we know what it is? what was the function? how was it produced/created? etc.

Workshop 02

The second workshop was focused on structure, form and function, as well as participatory features. The groups were presented with a prototype of the app, including an AR-mode visualizing the locations and the relations between them using the phone's camera (a few test-spots had been established).

Smartphones include several integrated technologies which offer many options in terms of functionality, e.g., a GPS, which can determine your exact geographical location, an accelerometer, which can determine what direction you are facing, and a camera, which enables you to shoot photographs and videos. In order to establish what kinds of features should be included in "Digital Threads across the Landscape", the participants were presented with various apps with different functions and participatory features. Some apps and other web-based systems allow users to leave something, e.g., a comment, a photo, a rating, a vote in a poll, or to participate in a discussion with other users. Others make it possible to take something away with you, e.g., sending a "postcard" containing pictures, videos and comments to other people. These options, as well as integration with social media, quizzes and competitions, visual presentation and tracking of the user's route and a setup similar to geocaching, were considered for "Digital Threads across the Landscape". One participant thought it would be nice to receive an e-mail with a link to her route through the landscape. Another suggested a clear visualization of which locations had been visited. One of the senior-participants thought her grandchildren might like the option of sending "postcards" to family and friends. However, much to the surprise of the professional designers, none of the co-creators were interested in the option of posting comments/photos or other "leave a trace" features, and they did not like the idea of integrating the app with Facebook or other social media. Overall, the co-creators were not too keen on user participatory features, and in the end it was decided not to integrate any of these options with the app.

The students also voiced the opinion that they did not like to be limited by a fixed framework or rigorous set of rules when using the app. They wanted to be able to browse contents and pick and choose between functions at their own leisure and in their own time – a curious and playful approach. This is very much in accordance with a Danish study investigating how young people use traditional museums, where fixed frameworks and guidelines for the experience were highlighted as reservations for not visiting museums in general (Kulturstyrelsen 2012).

Another subject discussed in this workshop concerned preparation before using the app on site. Individuals from both groups expressed that in using the app, they would like to be able to prepare themselves at home before visiting the locations in the landscape. In this way, they could act as guides and facilitators when visiting the locations as a part of a group - the co-creators imagined that they would use the app when being out and about with family and friends. In evaluating "Aarhus Street Museum" (a smartphone application which, among other features, can superimpose old pictures of modern buildings on-site (Den Gamle By 2011), the team behind the app learned that most people would rather download and use the app from home – and not as intended, in the streets of Aarhus[4]. This made us aware that "Digital Threads across the Landscape" should contain features and functions suitable for use both off- and on-site. Since one of the main ideas behind the project is to inspire people to go experience cultural history on location, it was important to construct a lure

that will entice people to go and visit the sites. These thoughts were incorporated in the creation of the special mode of AR, which is activated on site only. Thus, most of the contents are accessible from home or anywhere else the public desires, but in order to get the full experience with access to special features you will have to visit the location.

Workshop 03

The third workshop brought together both groups in order for them to get to know each other and forge links between the two age groups. This workshop was in two parts: testing a beta version of the app and preparing a storyboard for an animated film.

The app was tested with regards to contents as well as form/function and interface design. Based on input from the previous workshops, the museum curators had prepared the contents for a couple of locations and these were discussed and evaluated. The co-creators voiced that they did not like dense blocks of text, but preferred short texts intermixed with illustrations. They were also rather frank about which parts they found to be too heavy with jargon or flat out boring. It was very useful to get this kind of feedback at this early stage of generating content, as we were able to adjust immediately and follow these guidelines for additional locations. Another feature which was tried, and rejected, was a background soundscape, which was found to be distracting and too dominating of the overall experience.

In the second half of the workshop the co-creators prepared a storyboard for an animated film about the Hammerum girl, an Iron Age woman who was buried around 200 AD. It is a very remarkable find, with the best preserved Iron Age dress and hairdo from a grave context in Denmark. First, participants got a thorough introduction to the find in the exhibit. Then they were separated into small groups across age and gender and their creativity was set loose. The animated story of her life and demise had to fit the framework provided by the archaeological observations, but many aspects were left open to interpretation – and imagination - such as how she died and why she was buried in a rather secluded place. At the end of the session, the groups presented their ideas in plenum. All these ideas were incorporated into an overall storyboard, which, with a few adjustments, formed the basis for the film as it is today. The result is a 2 minute long animated film about the life, death and burial of the Hammerum girl, which is available through "Digital Threads across the Landscape" (accessible both on site and from home). It is also displayed in the museum exhibit next to the find itself.

User involvement proved such a success that the co-creators were invited to participate in a more informal writing session generating content for other locations. Some participants accepted the challenge, but outside the official writing session it proved difficult for them to allocate the time necessary to finish up their stories. However, the museum curators were able to modify some of the texts produced and incorporate these into the finished product. The co-creators' participation in generating specific content was very interesting and useful for the process, since it made us aware of what aspects of a find or location the users found relevant and exciting. These responses also served as guidelines for generating further content.

Workshop 04

The fourth and final workshop took place on-site and was focused on testing the functionality of the app with regards to the location-based technology and Augmented Reality, as well as the overall impression and experience of using the app outdoors. It proved to be a very different experience from testing indoors, where things like different weather conditions are not an issue, i.e., it can be hard to see what is displayed on-screen in bright sunlight or pouring rain.

The co-creators thought it was interesting to visit the locations and fun to use the special mode of AR activated on-site only, but they were quickly distracted by nature and other things going on in the immediate surroundings. They stressed that the app should be a supplement to the overall experience and not dominate the social aspects of a visit. Navigating and browsing the app should be intuitive ("we don't want to read long manuals in order to figure out how this works"), video and sound files should not be too loud or long, and texts should be short with lots of illustrations. In other words: keep it visual and simple in terms of content and features.

Extensive on-site testing also made evident the importance of accuracy when curators are determining the exact position of sites (by feeding coordinates and elevation data to the web-based editor tool). The smartphone as a mobile

medium still has some inherent issues when it comes to GPS accuracy. Therefore, it is key to the overall experience that the curators go visit the site after publication in order to make sure that everything functions correctly, and that the AR is displayed and the special mode of AR activates as intended.

Challenges in the process

Involving two groups of potential users as co-creators has been invaluable in the development of the app and ensured that the user experience stayed in focus all the way throughout the process as well as in the finished product. It has also caused the co-creators to take ownership and act as ambassadors for the app. The co-creators have contributed with knowledge, new perspectives and extra material, as well as hands-on user experiences with the smartphone as a medium for public outreach in general. They have challenged the museum professionals by questioning the way we traditionally tend to present culture history (in written form) and thus qualified "the good story" (content) but also challenged the way we communicate "the good story" (form). From a professional point of view it has been a challenge not letting the form of the app guide the contents and, moreover, to ensure that the app contains a high level of expertise and information – especially when generating contents in collaboration with non-professionals.

Involving non-professionals in the design process demands a lot of resources on the professional side. First, you have to recruit a group of people who are willing to commit to the project and actively participate in the process over the course of several months. Then you need to devote resources to keep them engaged through dialogue, workshops, evaluation and implementation of ideas generated. For this project it took a full-time employee who was responsible for recruitment and contact with the co-creators, as well as for planning, conducting and evaluating the workshops. It was a challenge for the co-creators to find time to attend the series of workshops. The seniors were flexible time-wise (their workshops could be carried out during the day), whereas the students were attending different schools and were otherwise occupied, so the workshops had to be held in late afternoon/evening. Initially, we started out with a few more students, some of whom eventually dropped out because they were not able to allocate the time to attend all of the workshops.

Preparing and evaluating the workshops was also time-consuming. It was important to the process that the co-creators would see the app develop based on their ideas and participation, so every workshop started with a summation of what had been achieved and implemented since the previous workshop and every workshop was thoroughly evaluated. Since three out of four workshops were carried out as parallel sessions, the ideas generated and points of critique were different for the two groups and it was at times challenging to link the interests of the two – very different – target groups. Still, we maintain the importance of parallel sessions that yielded insights into the special interests of the individual target groups but also identified the many points of common interest.

Even if challenging on many levels, we highly recommend involving potential users as co-creators at a very early stage of the design process instead of just bringing them in for evaluating the final stages or the finished product. This makes it possible to immediately test – and sometimes reject – new ideas as well as to optimize form, functionality and content along the way. It is challenging and difficult to bring non-professionals to the (design) table, but we feel it has been worth it because Museum Midtjylland ended up with a much better platform for public outreach specifically aimed at potential users.

Future development

"Digital Threads across the Landscape" was launched in June 2012, the official opening taking place on-site at two different locations with the support of the local community and politicians, and under the eyes of the media. The co-creators featured prominently, acting as facilitators and guides.

The app can be downloaded from App Store (iPhones) and Google Play (Androids), the project website[5] or qr-codes on posters at the museum and already existing signage in the landscape. As of April 2013, the app has been downloaded 838 times.[6] For the time being, the app includes sites from a limited area in Central Jutland (the area under the auspices of Museum Midtjylland), but we wish to expand with locations covering the entire region. Therefore, we are inviting other museums and institutions to collaborate with the project.

So far the app has proven to be a very dynamic platform for public outreach. Information as well as on-site experiences are at hand whenever the public desires. The app is also a useful tool for museum curators conducting guided tours in the city as well as in the countryside. Thus, "Digital Threads across the Landscape" has succeeded in bringing Museum Midtjylland's education and communication efforts to a new level, creating innovative experiences outside the physical museum space.

Notes

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[2] We wish to thank our co-creators, Birte Gade, Marcus Grøne, Ida Johannson, Sibel Ocalan, Nicolai Nielsen, Patrick Stephen Woods, Lene Christensen, Lars Hjorth, Rie Kibsgaard and Svend Eriksen for their dedicated engagement in the project.

[3] The project spanned a seven month period from December 2011 to June 2012.

[4] Personal communication between Kitt Boding-Jensen (from the design team, Museum Midtjylland) and Anneken Appel, Den Gamle By.

[5] http://www.digitaletraade.dk/getapp/

[6] According to the Alexandra Institute, which is hosting and monitoring the app.

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