

# Augmented and Mixed Reality Design for contested and challenging histories

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Maria Engberg, Malmö University, Sweden

## Abstract

This paper presents a series of mobile Augmented Reality Experiences focusing on the postcolonial history of various sites in Copenhagen, Denmark. The applications—*Bitter&Sweet* & *Finding Alberta*—are part of a university-led research project, situated at the now closed Royal Cast Collection of the Copenhagen National Gallery and in the city itself. Using site-specific archival material for contemporary experiences in an urban landscape, the design process deals in part with contested sites and sensitive histories, while the application tells the story of colonial pasts in a Danish context. We will discuss the process of designing for a locative, embodied experience; the challenges of providing an embodied and compelling experience for visitors both inside and outside of buildings; and the challenges of designing for the wider urban landscape, given the constraints of a small screen and the limitations of the mobile device.

**Keywords:** augmented reality, mobile design, location-based experience, Argon, cultural heritage, slavery

Cultural heritage institutions have long used digital technologies to support and enhance exhibitions. During the last decade, mobile digital applications have become more important for museums and other institutions to display information, highlight items that exist in the archives but are not physically on display, and to expand the scope of visitor participation. This paper discusses the historical background, design process, and technological experimentation involved in the ongoing projects *Bitter & Sweet* and *Finding Alberta*, both involving mobile applications. They are part of the larger research program *Living Archives* that focuses on critically engaging with cultural heritage and archival processes associated with mobile media, open data, storytelling, and performances (<http://livingarchives.mah.se/>).

During 2016 and 2017, we created mobile augmented and mixed reality (AR/MR) applications for location-specific experiences at culturally and historically significant locations in Copenhagen, Denmark. While by now there are quite a few AR applications for cultural heritage contexts, the design and experience of augmented and mixed reality interaction is still a developing field of research, and a continued challenge for interaction design (Engberg & Bolter, 2015; Barba & MacIntyre, 2011). Our central questions include:

- What kinds of interactions and experiences can be implemented for a larger audience?
- What is the readiness of visitors to engage with AR material?
- What are the aesthetic and learning dimensions of such experiences?

Recent research in interaction design have suggested that postcolonial studies and theories can be valuable for providing frameworks to handle analysis or interpretation (Mainsah & Morrison, 2014) or for signaling the global dynamics of power and wealth (Irani et al., 2010). Our work is framed as a design intervention that does not only represent and disseminate archival material but critically addresses the traces of slavery in Denmark. Smørðal, Liestøl, and Erstad (2016) have discussed location-specific augmented reality designs in an educational setting as a potential for situated and experiential knowledge-building (in their case, with dystopian scenarios of the future). Our project builds on the remediation of historical materials that have holes, gaps, or inconsistencies, or blatantly echo ideological and institutional politics of the past that can no longer remain unquestioned in the present. The project thus demands a situated and experiential knowledge-building that also includes a critical awareness of the complexities of the colonial past and the postcolonial present.

Our initial work, *Bitter & Sweet*, culminated in a mobile prototype and installations in and around the Royal Cast

collection of the Copenhagen National Gallery housed in the West India Warehouse. The name plays on the dual sensations of that location's bitter colonial history and the sweetness of the sugar import from the colonies to Denmark. The initial prototypes used image-recognition capabilities in Augmented Reality to overlay digital material, such as old films, onto surfaces and objects in the building. These prototypes were shown at a participatory event in February, 2016. During *Bitter & Sweet*, the Augmented Reality-enhanced sites in and around the Royal Cast collection of the Copenhagen National Gallery centered on postcolonial history in Denmark, but not on any particular historical individual.

The second application, *Finding Alberta*, developed late in 2016 and early 2017, traces the few parts that we know of the life story of a young black woman, Alberta Viola Roberts. She was taken to Denmark as a child from her native home of St Croix and arrived in Denmark in 1905 with a boy a few years older than her, Victor Cornelius. (He was later known as Victor Cornelins as his name was mistakenly taken down upon his arrival to Denmark). Recent research has found that the real reason the two children were taken to Denmark from the then Danish West Indies was *not* in fact education, as Victor wrote later in his memoirs (Cornelins, 1976), but rather to be put on display as a curiosity in the life exhibitions of the Colony Exhibition at Copenhagen's Tivoli (Andreassen, 2015). Alberta's life was short; she was educated for a few years before she died of tuberculosis in 1917 at only 15 years old. By an ironic twist of fate she was buried on Transfer Day, March 31, the day when the Danish West Indies became the US Virgin Islands. There is very little in the archives about Alberta. Victor remained in Denmark, became a teacher, and later wrote about his earliest years in Denmark with Alberta. Had it not been for Victor's memoirs there would remain very few personal details about Alberta's life.

## Stories in place

While much of the material about Alberta may be accessible in some form on the Web and on-site at publicly accessible archives, archival structures, search functions, meta-tagging of the material, and other parameters of the archives often make the material difficult to parse or even find. The few and vanishing traces of Alberta's life informed the main project idea: that we should tease out the details of her existence to create a narrative that addressed Danish colonial history while also paying attention to one individual. A clear aim was that this narrative should "live" outside the confines of archives or museums—that it should be connected to contemporary Copenhagen in some way. Even though Alberta and Victor themselves are gone, most of the buildings they lived in and streets that they walked through still remain. There are physical layers of history in the city that can be accessed and, indeed, augmented by way of digital technologies.

The project called for a representational technology that would allow us to join archival material to geographical places in a digitally mediated experience. A mobile Augmented Reality application fit those needs. Recent years have seen advances in Augmented and Mixed Reality applications that use the location-aware affordances of smartphones and tablets to geolocate information (Billinghurst, Clark, & Lee, 2014). Mobile devices also allow us to better understand how the user moves through the city, and how she interacts with the phone on individual sites. Ron Azuma's seminal definition of AR is still relevant in the context. AR should combine real and virtual content; it is interactive in real time, while digital content is registered in 3D on the device (Azuma, 1997). Early definitions of AR include other visual technologies such as Virtual Reality; most influential is the idea of the virtuality continuum by Milgram and Kishino (1994) which shows Mixed Reality as an overarching category that subsumes VR and AR as variants of visually dominant technologies. Recently, other registers of engagement have been included in definitions of AR and MR, such as sound, gesture, and full-body movement. Therefore, in the wake of technological improvements and ongoing re-conceptualizations of mixed reality (Rouse et al., 2015) this project sought a development platform that allowed for more types of AR/MR than the visually dominant type. In addition, the Living Archives project's stance on open data and access, and our own decision as individual researchers, meant that the design environment criteria required that the development environment be open source, use a sustainable programming environment, and allow us to maintain material storage on our own servers. We chose Argon, a javascript framework for adding augmented reality content to web applications (<http://argonjs.io/>). Argon, now in its fourth iteration, was developed by the Augmented Environments Lab at Georgia Institute of Technology (US). Argon allows you to create an AR view in a Web application using HTML and JavaScript without having to create native applications (Speiginer et al., 2015). The case for using Argon was strengthened by the fact that Argon as an AR browser allows you to use Web programming, thus ensuring

longevity and sustainability of the basic structure of the application. One of the main difficulties of creating content for mobile applications today is the continuous support needed to maintain continued use. Operating systems are frequently updated, requiring subsequent revisions of individual apps. Argon's HTML and JavaScript developer environment makes that process easier to handle.

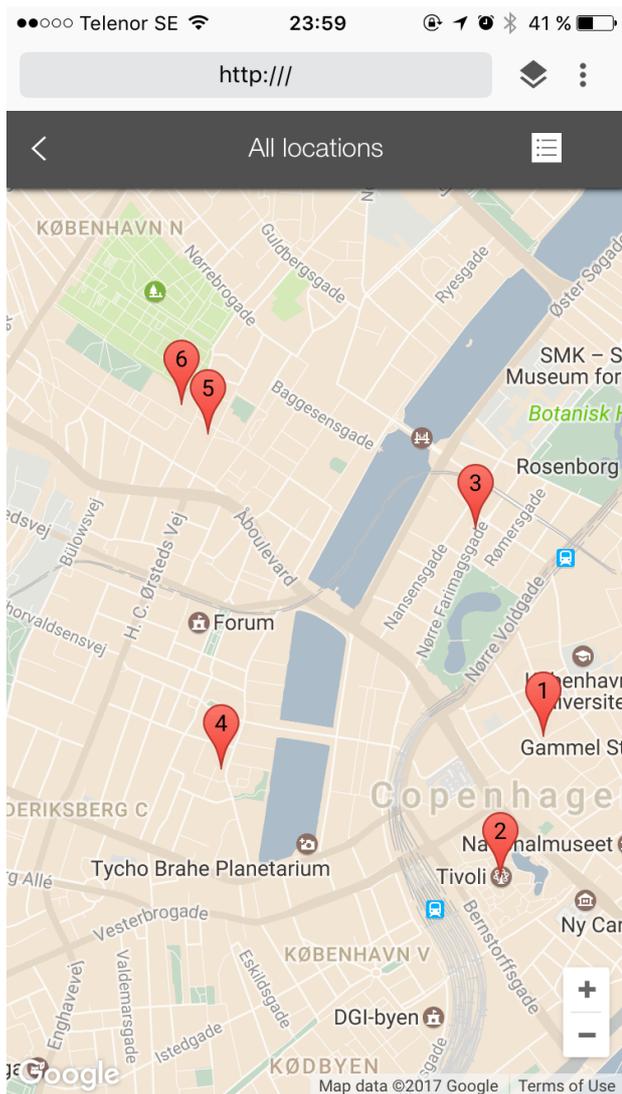


Figure 1: a screenshot of the map of locations during development. (Doris HB)

In the resulting AR experience, named *Finding Alberta*, the sites of memory are scattered across Copenhagen (figure 1). On seven sites of importance in Alberta's life in Denmark, we present the user with audio that recounts snippets of what is known about her experiences at each site, images and documents from Copenhagen at that time, and material from the colonies. At the time of this writing, the application is in an iterative development and testing phase, but what is already clear is that the challenge and allure of location-specific experiences that are mediated by mobile devices (phone or tablet) is the intermingling of the "now" and "then" at one particular point. Locating the experience in the urban environment allows us to reflect on how histories and knowledge happen at specific sites, and how the decontextualized materials in the archives stand to gain context, texture, and gravitas by moving into their original settings. At one site, for instance, a picture of the young Alberta taken in her school classroom at the beginning of the 20th century displays as the user enters that school building today. The school is still active, therefore the user standing on the city street may see children leaving the school at the end of the day, or imagine children sitting in the classrooms; from there, it is only a small leap of imagination to envision Alberta and Victor in that same building doing those very same things. As a mobile Augmented Reality experience, our design process involved paying attention to the place-producing dimensions of an experience-driven application, rather than one that merely presents site-specific information (Rouse et al., 2015).

Augmented reality, by its focus on the blending of virtual content, digital content, and the lived world, requires that the design of the application includes an understanding of the sites themselves. Finding Alberta's seven

locations necessitates that the buildings, streets, and other elements in the urban environment are taken into account when we design what appears on the screen, or what audio plays. The initial questions that informed the exploration and mapping of each site were as follows: where can the user stand in relation to the building or place that we wish to foreground? What other site-specific considerations need to be taken into account? How should we guide the user to each site? Locative media all require an understanding of how the position of the user device and the site-specific context interact with the digital design. As we place digital content onto a particular physical site, we need to consider the embodied potential frame for each individual user. These considerations range from the mundane (e.g., what is the site like at different times of day?) to the complex (e.g., what are the ramifications of inviting our users to stand outside a school that Alberta once attended when the school is still open today?).

As part of our preparatory process, we visited each site on numerous occasions, photographing and documenting its current character. The sites themselves were chosen from Alberta's life: the first site is on the street of the first apartment she stayed at when she arrived with Victor from St Croix; another site is the popular exhibition and amusement park Tivoli, where she was put on display during the Colony Exhibition (she and Victor were apparently put in a cage after Victor had begun to act out against spectators); and one of the last sites is the hospital where she passed away. Some of the streets and buildings no longer exist, and others have newer buildings in place of the ones Alberta knew. The city has changed, and so our own process of finding Alberta comes to the fore in the AR experience as well: with what strategies can we find and display the traces of a past that was not documented at the time and resist re-representation today in an altered environment?

## Tracing the archives

While we worked with scant archival evidence of Alberta's life, there are other materials and testimonies about what life was like for young black adults and children who were taken to Denmark at that time. Chief among them, of course, are the memoirs by Victor Cornelius, but also anecdotes and documentation of Virgin Island residents who were taken to Denmark for various purposes. Even fragments of voices, images, documents, and contemporaneous evidence of what life might have been like in the first decade of the 20th century in Copenhagen gave us a structure from which to extrapolate and add to, to allow for plausible explanations and stories to emerge. We propose that a truth of sorts, an authentic story, emerges from this amalgam of narratives and offers some insight into Alberta's life and the lives of others in similar circumstances.

At the same time, a defining concept in our archival and design work has been *care*: to take care and take responsibility for the daunting task of telling someone else's life. This care-taking was in play when researching archives. One example of how historically colonized individuals can show up in archives is presented in figure 2, a photograph taken in the Danish colonies, set on an archival card (one of many in the National Museum of Denmark's photography collections). Although this is not a photo we have used in the application, it belongs to the historical context in which Alberta lived. The Danish text reads in translation "A child of the Lachmann family. Upper Bethlehem, St. Croix." Nowhere on this card is the black woman holding the young Lachmann child named, described, or even mentioned; and yet she is there, clearly visible. The contemporary online collection of the archive to which this photograph belongs briefly describes the black woman as a nanny; however, it is clear that both contemporaneous and more recent sources were not interested in documenting all lives, only some, therefore, the task to foreground and give voice to those erased or made invisible falls upon us. As designers, exhibition producers, and curators, one act of care that emerges in our work is the creation of a plausible and perhaps even probable narrative, without doing violence to the real life events and memory of a historical individual. By telling the possible story of the woman holding the Lachmann child, we open up the archives for additional critical engagement as well as suggestions for revisions to the archival practices themselves.

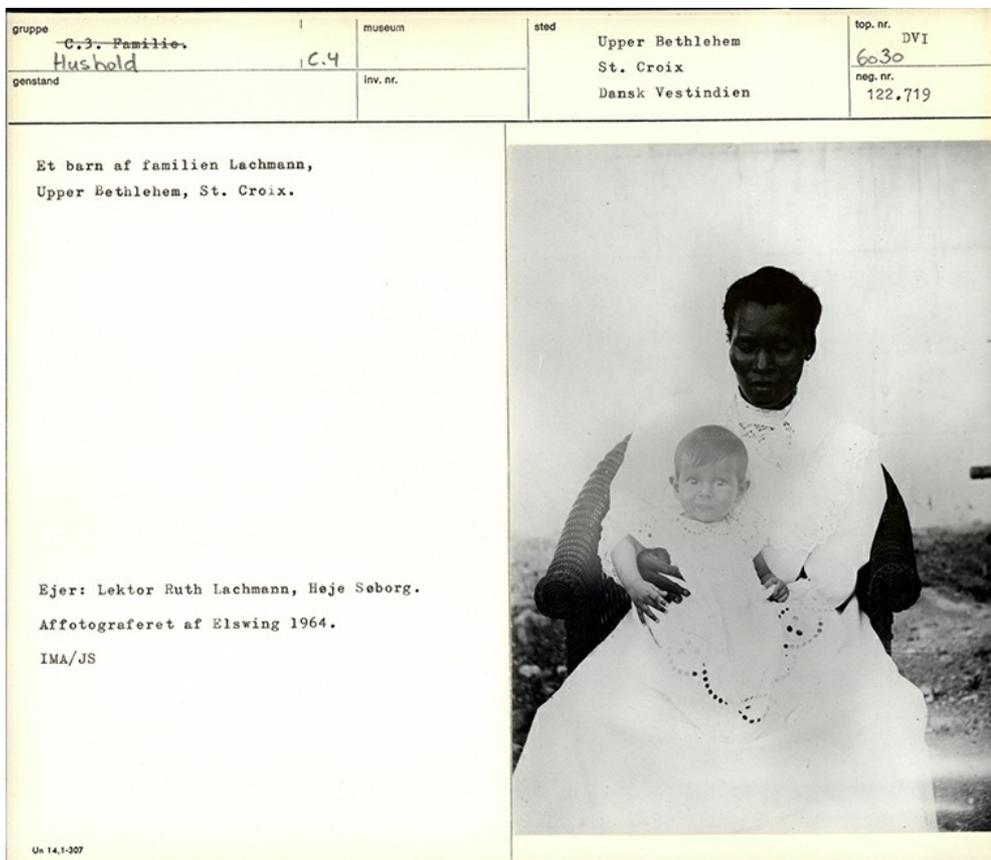


Figure 2: a photograph of a woman and a child, with documentation. (National Museum of Denmark).

By telling some of the stories of this troubled moment in Danish history and providing an experience that invites users to physically follow the traces of Alberta's life in Denmark, the project sets down anchor points that help users learn about, question, reflect on, and perhaps confront other historical narratives. The challenge of dealing with sites and stories that are potentially contested became a driving impetus for the project as a whole: we are working with difficult materials that foreground a colonial Danish past that some Danes and international visitors are not well aware of, nor is it necessarily foregrounded in the urban landscape through commemorations, statues, plaques, or other visible signs. However, there *are* signs in the city that contemporary visitors may no longer be able to interpret accurately. The historical significance of the West India Warehouse is more overtly present in the cityscape—in the name, if nothing else—than any trace of former residents in an ordinary residential building on a central Copenhagen street. Therefore, the most prominent stories of that colonial past live in archives and collections, many of which are being digitized and made accessible online. For instance, in the aforementioned Danish National Museum's online collections we find a photograph of a smiling Victor and Alberta, taken in 1905, just as they have been taken to be exhibited in the Danish Colonial Exhibition (figure 3). Nevertheless, these archival fragments do not constitute a full story.



Figure 3: a photo of Alberta and Victor, taken in 1905. The Danish caption reads “the negro children from St. Thomas.” (National Museum of Denmark).

## Postcolonial Computing and critical design

In the field of interaction design Irani, Vertesi, Dourish, Philip and Grinter (2010) have proposed the term “postcolonial computing,” a field that they suggest is “not a new domain or design space, but an alternative sensibility to the process of design and analysis” (Irani et al., 2010, 1311). They point to the ideological concerns that a postcolonial approach or sensibility bring to the fore: “Histories, power relations, and epistemology [that] tacitly underpin engagements in design.” (Irani et al., 2010, 1317). Further, a postcolonial computing approach to design challenges traditional or conventional design processes (such as identification of users, formulation of design requirements, ideation, and iteration) and instead suggests an alternative formulation of what the design process entails: “engagement, articulation, and translation” (Irani et al., 2010, 1317). We welcome the inclusion of postcolonial theories into the field of design and computing. Whether postcolonial theory or any other critical approach, the “alternative sensibility” that Irani et al. (2010) suggests can be articulated as a need for openness in the design process toward criticality. Mainsah and Morrison (2014) have pointed to the need for the more complex understandings of culture that postcolonial theory offers to design (their discussion focuses on participatory design). They argue that postcolonial perspectives can “reassert the value of alternative experiences and ways of knowing.” (Mainsah & Morrison, 2014, 85). Although Finding Alberta focuses on a colonial time, it takes place during Denmark’s sale of the West Indies to the United States. From the point of view of contemporary Copenhagen and the current cultural and political situation in Europe, a design process that includes postcolonial sensibility seems highly relevant. The representation of Alberta’s story in 2017, 100 years since the end of the Danish colonies in the West Indies (which coincided with her death) inevitably awakens discussions of our contemporary “questions of power, authority, legitimacy, participation, and intelligibility in the contexts of cultural encounter.” (Irani et al., 2010, 1311).

## Knowing Alberta

The application Finding Alberta is not yet available to the public. Once it is released, the next phase of our design process focuses on assessing how a multimodal, location-specific mobile AR application is received by a larger audience. Important evaluation questions include: what does the user make of the concurrent act of walking

down a street in 2017 while listening to voices from the past discuss how they walked that very same street more than 100 years ago? What are the implications of following the traces of Alberta around the city? Will the user seek out more information about a past that they may not have known much about before? Will they pay more attention to the buildings and urban environment around them, searching for clues to other histories and stories besides the ones at the very surface? Ultimately, the Finding Alberta experience thwarts any expectation one might have of truly knowing Alberta. So much of her life is unknown, undocumented. Our hope is that by that very act of learning what there is to know about her life in Denmark, users will seek out more stories like hers, and keep the memories of Alberta and her compatriots alive.

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