



Center for History and New Media

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Mobile for Museums

<http://chnm.gmu.edu/labs/mobile-for-museums>

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Summary

For many years, art museums have been at the forefront of offering their visitors learning experiences that extend beyond traditional exhibit labels with gallery kiosks and audio guides. More recently, art museums continue leading the way by adding cell phone tours, podcasts, and platform-specific applications in an effort to capitalize on the commonly-owned portable devices—iPods, MP3 players, Blackberries, cell phones—that visitors already carry in their pockets. Museum professionals see great potential in reaching new audiences and pleasing old ones by providing content and social interaction via mobile devices. The biggest challenge is that many museums do not quite know where to begin when working with a small budget and small staff with limited technical knowledge. This white paper addresses those needs by providing a brief overview of what is being done in the mobile museum world and offers suggestions based on this research on how to economically provide mobile users with a positive experience with your museum.

I. Assessment of the Field

A recent report by the Pew Internet and American Life Project predicts that by 2020, mobile devices will be the primary connection tool to the internet for most people in the world. With more than 75 percent of American adults owning mobile phones, and more young adults using these devices, mobile development is advancing at rapid rates. Even so, the mobile web is often difficult to navigate as most websites do not provide mobile visitors with options designed for mobiles.¹ Many individuals already use these personal devices to do something beyond making a phone call. Also understanding the scope and potential of mobiles, the New Media Consortium's 2009 Horizon Report recommends that museums and all institutions of learning implement strategies for offering content and access for mobile devices within one year.² Some institutions already incorporate mobile applications and mobile-friendly websites into their daily operations. A New Media Consortium survey conducted in October 2008 found 43 mobile projects in development, many based at universities addressing students and faculty needs at those institutions. A handful of other mobile projects targeted general audiences, even museum-goers.³

Museums are well on their way to adopting mobile strategies as found by a recent survey of museum professionals conducted by the Center for History and New Media (CHNM). CHNM found 67 percent of respondents, predominantly representing the history and art fields, have implemented or are in the process of implementing a mobile content delivery project. For those who did not provide mobile content, most replied that cost and staff time were the biggest hurdles, followed closely by lack of technical expertise. All of these hurdles are common problems for adoption of new technologies.⁴ For museums that offer mobile content, approximately 70 percent of them rely on a visitor's personal device or deliver content to a museum-owned device in addition to an individual's, one strategy that reduces overhead and sustainability often encountered by institutions buying audio tour listening devices. Museums created their content in-house and often relied on outside consultants or companies like Acoustic Guide or Guide By Cell to handle the technical requirements. When beginning these mobile projects, some of the participants consulted conference papers and online resources. Finally, many of these museums were evaluating usage of such applications and devices to improve the quality of user experiences.⁵

The most common format of content delivered to mobile devices is the podcast, even as museums experiment with cell phone tours and platform-specific applications. Podcasting is popular across museums, large and small and genre, because offering a podcast requires a very low barrier for entry in terms of skills, staff time, and cost. MuseumPods offers a running list of hundreds of institutions offering podcasts, or one can find them in iTunes or a museum's website. Cell phone tours provide the visitor with a self-selected in-gallery audio experience by calling a phone number to get more in-depth information about a painting, for instance. An average cell phone tour offers visitors twenty-five stops to listen to a curator, artist, or scientist talk about an exhibit element.⁶

The San Jose Museum of Art was among the first American museums to build an iPhone/iPod Touch tour that featured browseable gallery guides to augment the exhibitions' objects. These digital exhibitions offer short videos, including discussions with curators and artists.

Selections from the museum's permanent collection offer images and videos. The Brooklyn Museum of Art released their collections database API for public use which resulted in a company developing an iPhone application for the museum that gives users free access to their collections in and outside their galleries. Relying on a rich tagging schema, Brooklyn's application gives visitors the opportunity to search for art by tag or artist name. And for those who do not know what to look for, they may choose to randomize the collection. This randomization brings one to a painting by Thomas Birch followed by a shot glass designed by Tiffany Studios. Antenna Audio recently launched *Pentimento*, a system for creating iPhone application templates, with its first application called *Love Art*. *Love Art* provides access to select art collections and curator-narrated videos on the lives and art of masters from the National Gallery, London, including Rembrandt, da Vinci, and Van Gogh. Visitors may also scroll through different "insights" or themed tags, such as betrayal, faith, or light, to find videos on specific pieces.⁷ Opening collections and exhibitions for a mobile-friendly website or an iPhone or Touch application allows anyone to browse through art and related curated information in or outside of the gallery. While increasing access to museum collections, these applications limit the audience by platform, thus limiting the total audience able to enjoy such access.

In addition to offering deeper access to collections, mobile devices provide an excellent opportunity for exploring landscapes. When visiting Berlin, an individual may rent a *MauerGuide* that provides an extensive interpretative walking tour tracing the path of the former Berlin Wall and provides audiences with narration, film clips, and historic photographs throughout the tour. When walking through Houston's downtown Museum District, one may listen to a free narrated tour of the city. Users must download this tour as a podcast before arriving on scene and do not have a choice of where to start or redirect their tour. In San Francisco, visitors interested in learning more about the Jewish experience of the Fillmore District may listen to a cell phone walking tour, similar to those offered in some art galleries. These walking tours draw upon the resources of multiple institutions and offer a curious visitor access to interpretative content currently unavailable to someone walking around on their own.⁸

To reach broader audiences, a few museums are developing experiences that do not depend on a single mobile device by using semacode and texting. The Powerhouse Museum in Australia is printing out QR or semacode barcodes and placing them on museum object labels in galleries. When a visitor encounters a code, she or he photographs the bar code with their mobile camera and then the visitor is redirected to additional content about that specific object. The challenge with using these types of barcodes, as detailed by developer Seb Chan, are lighting, size of the barcode, and other variables that affect the quality of the photo and can hinder an individual from accessing the extras. Additionally, visitors must install a program that reads these barcode labels, such as *BeeTag* or *NeoReader*.⁹ These applications are small and easy to install, should the user decide to load them at home or in the gallery. To make the process easier, the Mattress Factory points visitors to a site to download a barcode reader while inside the museum. Once the reader is loaded, visitors snap a photograph of the barcode and may access short videos of artist interviews.

The Mattress Factory also uses mobiles to engage visitors in social networking with their ScreenTXT program. Visitors can ask questions, comment, or engage one another via Twitter or simple text messaging, and all of that information is aggregated through a free service called BriteKite that anyone may follow—inside or outside of the museum. At the National Air and Space Museum, visitor services experimented by offering visitors browsing in exhibit galleries the ability to text the information desk with questions about content and museum services. Through this experiment, the museum believed they were better serving the needs of their visitors and the museum is looking into offering this type of texting interactions more permanently.¹⁰ Since most visitors arrive on-site with an SMS-enabled phone, this mobile strategy for engaging visitors within galleries is much more inclusive.

In fall 2008, the Smithsonian American Art Museum introduced museums to the world of Alternate Reality Games (ARG) to combine web, mobile, and in-person interaction to uncover a mystery involving museum collections and the surrounding environs. “Ghosts of a Chance,” took participants around Washington, DC and into the museum over two months. One large component relied on participants’ phones for receiving SMS clues and texting answers to questions related to the mystery developed in the ARG.¹¹ [14] This type of public program requires a major investment in staff resources, but offers an example of how museums can use mobile technologies to meaningfully engage their visitors around museum objects and the communities where they live.

For those interested in exploring the possibilities of incorporating mobiles for museums, we find the museum mobile development community is welcoming and encourages collaboration. Leaders in this subfield, including Nancy Proctor at the Smithsonian American Art Museum, encourage all to share presentations on best practices and lessons learned through a variety of blogs and wikis, in addition to following the #mtogo tag on Twitter. One may begin hunting through the resources available at the Tate Handheld Conference wiki, the MuseumMobile blog and Museums-to-Go working group wiki, or from the Museums and the Web Conference. In an effort to gather these resources and websites into one accessible place, CHNM created the “Museum Mobile” Zotero group that is open for anyone to join and add or annotate resources.¹²

II. Development Recommendations

Based on our survey of current mobile usage in museums and the available information about programs that are in development, we are making several recommendations that we believe will make mobile development more efficient and will advance the state of the field. Some of these recommendations are relatively simple and will help to insure that museums reach the greatest audience possible to extend the reach of a museum’s current efforts. Our other aim is to push museums to think in new ways about the kinds of interactions they want to have with visitors that mobiles may help to facilitate.

Nancy Proctor reminds us constantly, “it’s not about the technology,” so focusing on the types of experiences you can give to or foster with visitors with mobile technology is a key point to remember. Mobile hardware is not designed to last longer than a few years. Understanding this

reality, we agree with Koven Smith and advocate moving quickly to test and implement new mobile work. Not all development must follow traditional development and implementation calendars, which can be as long as two years per project. The rapidly changing environment of mobile hardware and user interface expectations demands that we try to implement new mobile work quickly, using flexible web development and publishing platforms. This might mean building discreet web applications that can run on multiple platforms. Or, it might mean making better use of existing social networking platforms or applications. Either way, museums need to push into the stream of innovation to reach users in new ways.¹³ [4] Given these concerns, we move forward with our development recommendations on two fronts: Infrastructure and Technology, and Content and Implementation.

A. Infrastructure and Technology

§ Cross-Platform Development

Current development is myopically focused on the iPhone application platform. While Apple holds a major share of the smartphone market, the iPhone is far from being the only device carried by museum visitors and members of the interested public. The Android phone and the Palm Pre have joined the Blackberry in sharing a percentage of the smartphone market. Unlike the dominance of the iPod in the music player market, the iPhone will continue to face innovation and competition from other device makers.¹⁴ Thus, we advocate for solutions that allow for cross-platform delivery of content through either mobile browsers or development of specific smartphone applications.

One solution to the ever-changing landscape of mobile devices is to circumvent the question of platform by designing for mobile web browsers rather than operating systems. A museum with an existing website can create a special mobile Cascading Style Sheets (CSS) that makes that museum's website easily accessible by a variety of devices. Respected web designer, Cameron Moll argues in his book *Mobile Web Design*, that the use of a mobile style sheet with an existing site and the notion of narrowly conceived mobile-only design approach will dominate mobile content delivery "for the next couple years as new devices and browsers enter the market offering great content zooming experiences but also leveraging mobile-exclusive technology such as location awareness and camera/video capabilities." In addition to Moll's text, the World Wide Web Consortium (W3C) and web design blogs, including A List Apart have published best practices when designing for mobiles to ensure for broadest accessibility.¹⁵ The advantage to this approach is that it does not require users to download anything ahead of time, such as applications, podcasts, or barcode readers.

Museums can use this technique to make their existing web content available to users on the move, but they may also want to create a site specifically-designed for mobile devices that contains few graphics and simple navigation. Both of these solutions allow museums to deliver mobile content by building on a dynamic web publishing platform or content management system. Using CSS and XHTML to draw content out of standards-based databases provides museums with a level of flexibility that is key to our other recommendations.

Certainly, mobile browsers have limitations. Users are frequently unable to experience multimedia content because mobile browsers do not allow for the Flash or Quicktime plug-ins necessary to access those files within the confines of the browser. Thus, if institutions want to offer multimedia content or opportunities that reach beyond a mobile web browser's capabilities, there are frameworks that allow designers to build an application to work across platforms. A few services, such as Zirada, Hot Lava, and MobiOde, create cross-platform content including quizzes and surveys. Even some programs allow you to develop iPhone and Android-specific application based on MySQL databases that you build without needing programming experience, such as Widget Press's Model Baker. While these programs provide an easy entry into the mobile application design world, those do not appear to deal well with art museum content, particularly images, audio, or video. Phone Gap, on the other hand, is an open-source tool for building mobile applications that uses JavaScript language that can more easily deal with dynamic content.¹⁶

§ Reuse or Aggregation of Content

Many museum professionals working on mobile project development seem to be developing unique content materials for mobile delivery only. This leaves engaging content-rich materials isolated in one platform that is sometimes tied to a particular handheld device. Given the scarcity of resources and staff in today's museums, we recommend that content be developed so that it can be repurposed and accessed for the maximum number of venues. There are a variety of stable open source content management and web publishing systems (Omeka, Joomla, Drupal, etc.) that can reduce a museum's software investment while at the same time increasing their flexibility. These database driven systems provide content through an number of outputs, including full collection listings, narrative exhibits, and a variety of feeds. Thus, museum IT staff can create a central repository of digital content that curators, museum educators and other staff members can select, combine, and recombine in a multiple ways. In the long run, this approach to content delivery extends the reach of an institution's digital resources.

Content from the main museum website can then be made available to a mobile application through feeds (RSS, JSON, XML) or through an API such as the one released by the Brooklyn Museum. These streams of information can take content to where the users are in a dynamic way that responds to their interests and needs. Thus, regardless whether an institution has chosen to provide access through the browser or by way of a particular application, we recommend that mobile content be drawn from a content management system that allows museum to more easily repurpose, update, and serve visitors a variety of information.

B. Content and Implementation

§ Beyond the Gallery

Overall, we have found that a majority of museum mobile projects concentrate on in-gallery experiences. There is significant and innovative work going on in this area such as the Brooklyn Museum of Art's new customizable gallery tours for smart phones. But, this focus leads to work on projects that resemble audio tours with additional multimedia, with some notable exceptions. And,

many projects require users to prepare for their visit by downloading content prior to arriving at the museum. We believe that this narrow perspective fails to fully exploit the possibility for mobile technology to facilitate user experience and interaction with collections beyond the walls of the museum.

We do not want to discourage the efforts of museum curators and technologists who are working on in gallery applications, but rather we encourage staff to think beyond the gallery experience to realize the full potential of mobile projects to reach audiences outside the gallery as well. We have seen the successful results of the Flickr Commons project to push users interested in photography from the Flickr site back to the institutional home of the contributed content. Capitalizing on an increasingly high number of mobiles offering GPS, wifi, or 3G service, museums can use geolocation data to connect their collections with other institutions or mobile sites. Providing users with access to collections as they move around the landscape has the potential to draw them into the brick and mortar museum and to capture the attention of users who might not think of themselves as typical art museum patrons. On this principle, we suggest that museums consider thinking about the the world outside of the traditional museum gallery as a staging ground for introducing mobile users to museum content. Mobile applications and browsing can provide tourists, new visitors, and dedicated patrons with new ways to experience museum content by capitalizing on place, artist, theme, and time as organizing principles for content delivery.

With this recommendation in mind, we have developed a sample project called *Art in the City* that suggests some of potential ways for museums to move beyond their gallery walls with mobile computing.

§ Meaningful Engagement

Museums desire to engage visitors in meaningful ways and continue to struggle how best to achieve those goals. Until recently, mobile developers within museums primarily conceived of the mobile device as a one-way path for content delivery. Concentrating only on content delivery forecloses the tremendous possibilities to capitalize on user interaction and user-generated content. We encourage museums to invest in ways for their visitors to communicate about the materials in their collections. There are a variety of methods for doing this. For example, users could be invited to leave a comment about a particular item, or use a simple rate and review system that can facilitate visitors helping each other to view art based on similar likes or dislikes. For museums seeking to connect strangers within the museum's walls, mobiles can facilitate this type of interaction. Sharing bookmarks or links to particular object through a text messages or email, or via personal social networks allows visitors to personalize content and use it in ways that they find useful to them once they leave the museum. Tracking this visitor traffic and comments will feed into the museum's understanding of how visitors experience their content. Additionally, museums can set up local phone numbers using internet phone services, such as Skype, and ask visitors to call in and share their opinions or experiences related to an exhibition or their gallery experiences. If a museum wishes to establish a digital archive of user-contributed content to commemorate a particular event,

creating a mobile-friendly site that receives textual, visual, and audio materials will greatly increase the chances for the archive to grow and thrive.

By experimenting with mobile projects, we believe that museums can not only establish better relationships with their visitors that foster a sense of stewardship for the brick and mortar museum, but also help both the museum's staff and visitors build meaning around art and objects that matter to their community.

III. Implementation and Prototypes

Based on these findings, we have created three different prototypes that attempt to put our recommendations into action quickly and inexpensively. These examples are simply proofs of concept, but we hope that by making them available and discussing the process of their development we will provide the museum community with some fresh possibilities for mobile development. We hope that these examples will spark conversation and encourage more institutions to develop and experiment with mobile-based programs quickly. By pooling all of our experiences and best practices, we can move the field of mobile technology for museums forward and continue to think critically and creatively about how to facilitate and enrich the experiences of a variety of audiences.

A primary focus of our implementations has been to extend and utilize pre-existing software frameworks and standards. This approach to mobile development avoids having to start from scratch every time an institution wishes to launch content for mobile, saving valuable resources. Lowering the barrier-of-entry for institutions is a high priority, and a modular approach fits into diverse workflows to meet institutional needs. Our prototypes originate from an Omeka site that publishes museum collections online. That content can then be sent to mobile devices and easily accessed with a mobile browser. Third, we built a native cross-platform mobile application. We built these prototypes using open source software to share our code in the hopes that other developers will use it to build their own mobile projects and then share their open source code and project ideas with the greater museum community.

1. Produce and use Omeka plugins that will facilitate the development of in-gallery mobile work.
2. Launch a cross-platform mobile website that brings collections to people outside of museum walls.
3. Harness power of mobile devices through native cross-platform applications.

§ Omeka Plugins for Mobiles

Produce and use Omeka plugins that will facilitate the development of in-gallery mobile work.

Understanding that many museums are focused on creating mobile experiences for users who are within the walls of the museum, we would like to highlight the plugins that are available for use with the Omeka web publishing platform that will facilitate this work. Omeka is free and open source, as are all of the plugins that work to extend the basic software's functionality. Once a museum makes its in gallery content available through an Omeka installation with a mobile stylesheet, the following plugins could be used to extend the mobile experience:

- [Barcode-Reports](#): This plugin allows curators and technologists to print a QRCode and place it next to a museum object or on a object label. Visitors who have mobile devices loaded with one of the several small QRCode reader applications (mentioned above) can photograph the code, which translates into a URL. From that link, visitors will discover additional information that you offer to them, including metadata, videos, audio recordings, or images about that particular item.
- [Geolocation](#): This plugin allows curators and IT staff to array collections on a google map so that users can experience museum content through a spatial orientation. If a museum desires to engage visitors outside of the gallery, geolocated objects might attract additional visitors.
- [Location-based-search](#): This plugin extends the Geolocation plugin, and allows individuals to search for items in an Omeka site based upon a specific street address, or latitude/longitude. This plugin has been integrated with the native cross-platform application listed as the third prototype, and allows users to find objects around them.
- [Contribution](#): This plugin allows users to submit a story or reflection on a particular element of mobile content, whether it be a particular item, a collection or an entire exhibit. The contributed reflections can then be made available for other users to browse.
- [Social bookmarking](#): This plugin allows a mobile user to share an item's link to any one of many popular social networking or bookmarking sites, such as Delicious, Facebook, Myspace or Digg. Users make meaning independent of the museum when they save content and share it with their friends in their own web space.
- [Send to mobile](#): This plugin allows website visitors to send information about the location and institution of an artifact to a mobile device, either by text message or email. If a user visits the website prior to a museum visit, they can conveniently use this as a way to remember things to see during their visit. Or, a user may text a nearby friend or family member to ask them to come over and see a cool artifact. Similarly, users can easily text object links to friends who might be visiting a venue in the near future. Users without smart phones can easily use text messaging (SMS) to share information and access content from an institution's website.

- [Enhanced JSON Output](#): This plugin creates a lightweight data feed of information from an Omeka website, including item and collection information. Created specifically for mobile clients, this provides an optimal way of exchanging information between a server and mobile application. (<http://code.google.com/p/art-in-the-city/>)

Batch uploading for creating a mobile-friendly Omeka site:

- [OAI-PMH Harvester](#): This plugin allows metadata from pre-existing OAI-compliant repository (such as ContentDM) to be harvested into an Omeka installation. If an institution already has collections that they wish to feature in a mobile website, they can use this tool to select and transfer that information and avoid the work of having to manually replicate pre-existing data.
- [CSV Import](#): Similar to the OAI-PMH harvester plugin, the CSV Import plugin is designed to migrate data into your Omeka installation. CSV, which is short for comma-separated-values, is one of the most-basic data formats, and makes Omeka interoperable with a large number of systems that an institution may already have.

Both plugins offer museums and quick way to share collections data among institutions, and to set up a mobile-specific site.

Developing and extending Omeka for mobile projects requires less initial work because the system already maintains an archive, and provides an easy way for developers to focus on the functionality of a plugin. The plugin architecture implemented in Omeka allows for a variety of customizations that can be tailored to specific institutions and initiatives. The examples listed above demonstrate that Omeka offers several ways for museum professionals to integrate pre-existing collections into a mobile site, saving time and resources. Additionally, museum visitors will find different ways to interact with content using their mobile device. Future plugins may offer similar and new functionality, and be shared across institutions. Omeka's flexibility offers institutions multiple ways to design and implement a mobile project.

§ Sites Optimized for Mobiles

Launch a cross-platform mobile website that brings collections to people outside of museum walls.

The second prototype integrates several Omeka plugins into a mobile-friendly website. To build a mobile-friendly website from scratch, we created Art in the City <<http://dev.omeka.org/artinthecity>> to showcase this mobile integration by combining a customized theme with several plugins for a unique mobile experience. There were two distinct steps to launching the collections-based mobile website: organizing and presenting collections, and optimizing the mobile web design, including adding and customizing plugins.



Art in the City homepage

We began by filling our Omeka database with images relating to four sites in Washington, D.C. A person walking around D.C. may access Art in the City from their mobile device and find the Capitol building, for instance, in the list of locations. Once selecting the location, the user discovers images and art from a variety of institutions that relate to the history and use of the Capitol building as a political and cultural icon. One more click takes the visitor to metadata if she or he desires more information about the digital object, and tells the visitor what institution holds that object. By adding fields to the existing metadata, institutions can also tell visitors if an object is available for viewing in a public space. Creating a cross-institutional mobile browser-friendly site offers an out-of-gallery experience, where users can access the resource from virtually anywhere.

To offer a mobile site that rendered similar results in all major mobile browser, we modified a pre-existing Omeka theme, Emiglio. We modified the theme's CSS by reducing the width and padding of the header, footer, navigation, and columns, and adjusted the font sizes of headings and the body, so that the design fits comfortably within the confines of a smaller mobile browser window. With the design in place, we focused our efforts on the curation of content.



Screenshot of mobile interface

Once we created a small archive for [Art in the City](#), we installed the new Send to Mobile plugin. Send to Mobile allows users browsing the site to send specific information about the artwork in the archive—determined by the project team—to a mobile device via text message (SMS) or email. We imagine two common scenarios incorporating the Send to Mobile feature. First, an individual might visit the website prior to visiting, and choose to text themselves selected objects to view at the museum. Alternatively, once at the museum, a visitor might text a friend or family member browsing in another gallery or wing of the museum to alert them of an interesting artifact or piece of art. Once downloaded to their phone, anyone may access the information in that text, even if cell phone reception is not available within the museum itself. Offline mobile integration provides another way to deliver content to users, and diversifies the options available.

Lastly, we created a [BriteKite wall](#) to encourage visitors either to text or tweet using the hashtag, #artincity. The wall is linked from the site's homepage and encourages anyone to contribute to or follow conversations and commentary related the Art in the City site.

[Art in the City](#) offers a prototype that is easily replicable for other museums seeking to pilot their own collections-based mobile site.

§ Native Cross-Platform Applications

Harness power of mobile devices through native cross-platform applications.

Developing an application for multiple mobile platforms (Android, Blackberry, and iPhone) has proven to be the most challenging piece of this project. Unlike the browser-based solution, a native application does not run on the web browser, but on the device itself. An application will run at an optimal speed and offer the user the functionality of a phone that is not available in a web browser, such as the device's GPS, vibration, accelerometer, camera, or phone. But mobile devices rely on platform-specific development that requires programming in different languages, and imposes different limits on how code can be shared and licensed.

We understand that it is difficult for museums to develop for multiple platforms, so in order to help the museum community reach the broadest possible audience, our goal was to create a single development solution that works across three major platforms: Android, Blackberry, and iPhone. We hope to encourage further cross-platform development, which is why we are releasing this open-source code to our prototypes. Go directly to the code: <http://code.google.com/p/art-in-the-city/>

We developed our prototype application in Phonegap <<http://phonegap.com>>, a cross-platform framework for building mobile applications. Phonegap allows developers to create mobile applications that are native to devices, programmed using only HTML and javascript that seamlessly integrate with device-specific installations. By using HTML and javascript, traditional web developers can now create mobile applications without requiring them to learn a new programming language, such as Objective-C or Python. In addition to being based upon these basic technologies, the pool of available developers with the necessary knowledge base to use Phonegap is much larger than for other languages, which makes using Phonegap an economical choice.

The Phonegap application relies on the Art in the City Omeka installation we already created. There is a client/server relationship between the mobile application and the Omeka database. When a user installs and opens the mobile application on their device, our server is pinged to download specific data. When returning data to the device, the application formats that data in a specific way. This basic API (application programming interface) allows the application's users to receive recently-updated information from the live Omeka installation.

In order to exchange data between the Art in the City website we created, and the mobile application developed using Phonegap, we needed structured information that could be accessed remotely. A variety of formats are favored online for exchanging data, such as XML-based specs such as RSS and RDF, or OAI-PMH. After several performance tests, we chose to access Omeka data using JSON, because the size of files containing information for the mobile device are smaller. The amount of data sent from the server to mobile application is an important consideration, especially if users have limited bandwidth or slow cellular connections. Omeka natively has a JSON

output format, however we chose to create a plugin which provided additional metadata. The Enhanced JSON Output plugin shares data about museum collections, artwork, tags, and other information such as featured artworks.

Javascript is used within the mobile application to retrieve and display data from the Omeka website. To avoid starting from scratch, we used jQuery, which is a popular javascript framework. By using jQuery, the javascript code developed as part of our mobile development already performed several basic actions, such as displaying and hiding content on the screen, and retrieving data from a remote server. We focused on implementing code that would integrate with Omeka, and be reusable on other Omeka sites in the future. Similar language was used in the javascript as found in Omeka's code, so that a developer who is learning both systems could avoid having to learn two different approaches to displaying collection data.

Accessing a mobile device's hardware, notably GPS, distinguishes a mobile application from the mobile-optimized website. Most of today's smartphones including Blackberry, Android, and iPhones come with a GPS that provides the geolocation of the device as it is being used. By integrating GPS functionality into our native mobile application, we are able to provide location-based search. When a user opens the application, they see a splash screen notifying them that the GPS will plot their current location. All artwork displayed within the application will be ordered based upon the physical distance from the user, and users will see the distance calculated for them. So, if a user stands at a street corner, they might discover four pieces of public art located within a 0.5 mile radius from where they stand. The user also may access more information about those artworks by browsing on their phone.

Finally, we compiled all of the code used in our mobile projects. We generalized the Phonegap code so it may be translated into the necessary language for each mobile device. Compiling this code creates a file which can easily be downloaded onto a Blackberry or Android device. iPhone applications, however, must be approved by Apple before anyone may install them. Once approved, the application will be available in the Apple application store.

All code developed for these prototypes is available to download on Google Code, (<http://code.google.com/p/art-in-the-city/>). We released this as open source and invite anyone to test and expand it, and then to contribute back to the museum community by sharing your enhancements.

IV. Resources

- Full bibliography available in public Zotero group, Mobile Museums:
http://www.zotero.org/groups/mobile_museums/items
- Museums and Mobile Adoption Survey questions:
http://www.surveymonkey.com/s.aspx?sm=KrJUX778buWWN90N6V4Bsg_3d_3d
- Museums and Mobile Adoption Survey responses:
<http://spreadsheets.google.com/pub?key=p4mHRu1XWBw-OV7-8hNvXIg>

Notes

¹ Janna Anderson and Lee Rainie, Pew Internet: Future of the Internet (Pew Internet and American Life Project, December 14, 2008), http://www.pewinternet.org/PPF/r/270/report_display.asp; Ed Baig, “Study: Mobile Web a Throwback to the '90s,” USAToday, July 17, 2009, <http://blogs.usatoday.com/technologylive/2009/07/do-you-have-a-tough-time-getting-anything-more-complicated-than-talking-done-on-your-cellphone-small-wonderresearchers-at-n.html>.

² New Media Consortium and EDUCAUSE Learning Initiative, 2009 Horizon Report (New Media Consortium, 2009), <http://wp.nmc.org/horizon2009/>.

³ Alan Levin, New Media Consortium, “What is Your Mobile Project?” blog post, October 12, 2008 (<http://www.nmc.org/2minute-survey/mobile-projects>). This survey did not ask about institutional sponsorship, although many offer that in the project descriptions. Out of the 43 projects listed, 36 are university-based, 7 target general users (and may have been developed by a university); and 5 target museumgoers (and may have university development).

⁴ Museums and Mobile Adoption Survey, Center for History and New Media, open from January 31-April 1, 2009. See our questions from Survey Monkey:

http://www.surveymonkey.com/s.aspx?sm=KrlJUX778buWWN90N6V4Bsg_3d_3d; Survey results are available from Survey Monkey:

http://www.surveymonkey.com/sr.aspx?sm=mpcriZYeT32X_2fVfFtpvGGdO3OZb4eP9azwlmPd8uDew_3d and in a Google Spreadsheet: <http://spreadsheets.google.com/pub?key=p4mHRu1XWBw-OV7-8hNvXIg&gid=0> We asked museums to tell us what type of institution they worked at, rather than providing limiting vocabulary. History museums, for the narrative, include museums, historic houses, and historic ships. Art museums include university art museums and art centers. We also had six museums that treat multiple genres of collections, which we counted separately but generally included art or history as one of their main fields.

⁵ Once content is created and delivery systems are in place, less than half of the respondents report that they evaluate user interaction and/or statistics. Museums and Mobile Adoption Survey, 2009.

⁶ “Museum Podcasts Podcast Directory,” <http://www.museumpods.com/index.html>; For detailed information on how museums are using cell phone tours in their exhibitions, see: Cell Phone Snapshot: Results of a 2009 Cell Phone Audio Tour Survey, Survey (Museum-Ed.org, July 7, 2009), <http://www.museum-ed.org/content/view/106/53/>.

⁷ San Jose Museum of Art’s iPhone/iPod Touch tours are available here: <http://sjma.mobi>. For more information about the development of this application see the following posts: Chris Alexander, “iPod Touch Tour Update,” blog, chris-alexander.com, October 17, 2009, <http://www.chris-alexander.com/2008/10/ipod-touch-tour-update/>; Chris Alexander, “iPod Touch Tour Full Screen Mode,” blog, chris-alexander.com, February 6, 2009, <http://www.chris-alexander.com/2009/02/iphone-full-screen-mode/>; Shelley Bernstein, “Brooklyn Museum API: the iPhone app,” blog, Brooklyn Museum: Community: bloggers@brooklynmuseum, April 17, 2009, <http://www.brooklynmuseum.org/community/blogosphere/bloggers/2009/04/17/brooklyn-museum-api-the-iphone-app/>; Antenna Audio, “Pentimento,” product site, Pentimento, <http://www.discoverpentimento.com/>.

⁸ MauerGuide: <http://www.mauguide.com/index.php?m=1&s=4>; “Museum District Walk and Roll”: <http://www.audisseyguides.com/houston/museumdistrict>; “Jews of the Fillmore”: <http://www.magnes.org/fillmore/tour.html>.

⁹ Seb Chan, “We are (partially) mobile - Powerhouse on your phone,” blog, Electronic Museum, February 28, 2009, <http://www.powerhousemuseum.com/dmsblog/index.php/2009/02/28/we-are-partially-mobile-powerhouse-on-your-phone/>; Seb Chan, “QR codes in the museum - problems and opportunities with extended object labels,” blog, Fresh + New(er), <http://www.powerhousemuseum.com/dmsblog/index.php/2009/03/05/qr-codes-in-the-museum-problems-and-opportunities-with-extended-object-labels/>; Seb Chan, “A quick QR code update,” blog, Fresh + New(er), April 8, 2009, <http://www.powerhousemuseum.com/dmsblog/index.php/2009/04/08/a-quick-qr-code-update>.

¹⁰ Jeffrey Inscho, “Two Tweets Passing In The Night - SCREENtxt Part 1,” blog, Mattress Factory, January 29, 2009, <http://artyoucangetinto.blogspot.com/2009/01/two-tweets-passing-in-night-screentxt.html>; Jeffrey Inscho, “Mattress Factory | Weblog: Making It Work - SCREENtxt Part 2,” blog, Mattress Factory, February 23, 2009, <http://artyoucangetinto.blogspot.com/2009/02/making-it-work-screentxt-part-2.html>; Vicki Portway, “Mobile NASM,” wiki, SI Web and New Media Strategy, May 21, 2009, http://smithsonian-webstrategy.wikispaces.com/page/diff/mobile_NASM/74694883.

¹¹ Georgina Bath, Ghosts of a Chance Alternate Reality Game (ARG) (Washington, D.C.: Smithsonian American Art Museum, November 6, 2008). Georgina Bath Goodlander, “Fictional Press Releases and Fake Artifacts: How the Smithsonian American Art Museum is Letting Game Players Redefine the Rules,” in Museums and the Web 2009:

Proceedings (presented at the Museums and the Web, Toronto: Archives & Museum Informatics, 2009), <http://www.archimuse.com/mw2009/papers/goodlander/goodlander.html>.

¹² MuseTech Central, Museum Computer Network, <http://musetechcentral.org/>; Tate Handheld Conference Wiki, <http://tatehandheldconference.pbwiki.com>; “Bibliography | Mobile,” conference.archimuse.com: the online community of museum informatics professionals, <http://conference.archimuse.com/biblio/keyword/mobile>; Nancy Proctor, “MuseumMobile,” blog, MuseumMobile: Media and Technology on the Go, <http://museummobile.info/>; collaborative authorship, “MuseumMobile Wiki » Museums to Go,” wiki, <http://wiki.museummobile.info/museums-to-go>; Mobile Museums Zotero group: https://zotero.org/groups/mobile_museums.

¹³ Koven J. Smith, “The Future of Mobile Interpretation,” in Museums and the Web 2009: Proceedings (Toronto: Archives & Museum Informatics, 2009), <http://www.archimuse.com/mw2009/papers/smith/smith.html>. Doug Aamoth, “MIT students build mobile applications in 13 weeks,” blog, CrunchGear, December 12, 2008, <http://www.crunchgear.com/2008/12/12/mit-students-build-mobile-applications-in-13-weeks/>. You can find Nancy Proctor discussing her main point in many of her presentations and in various blog posts collectively found at MuseumMobile: <http://museummobile.info/>.

¹⁴ Alana Semuels, “Smartphones now have one-third of market share globally, report says,” Los Angeles Times Technology blog (March 24, 2009) <http://latimesblogs.latimes.com/technology/2009/03/android-smartph.html>.

¹⁵ Cameron Moll, Mobile Web Design (Cameron Moll: 2008) 42, available at <http://mobilewebbook.com/>; Best Practices Working Group, W3C, “Mobile Web Best Practices 1.0,” July 29, 2008, <http://www.w3.org/TR/mobile-bp/>; two examples of such articles from A List Apart are: Elika Etemad and Jorunn Newth, “A List Apart: Articles: Pocket-Sized Design: Taking Your Website to the Small Screen,” A, August 31, 2004, <http://www.alistapart.com/articles/pocket/>; Dominique Hazael-Massieux, “A List Apart: Articles: Return of the Mobile Style Sheet,” blog, A List Apart, January 6, 2009, <http://www.alistapart.com/articles/returnofthemobilestylesheet>.

¹⁶ “PhoneGap | Cross platform mobile framework,” <http://phonegap.com/>; “GotZapp,” <http://gotzapp.com/>; “Hot Lava Software Mobile Learning,” <http://www.hotlavasoftware.com/index.php>; “iWriter – Create study tools for iPod in minutes,” <http://talkingpanda.com/iwriter/>; “MobiOde | Mobile surveys,” <http://www.mobiodede.com/>; “Widget Press - ModelBaker,” <http://www.widgetpress.com/modelbaker>.