

Libraries and Archives Augmenting the World

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The future is already here—it's just not very evenly distributed.

—William Gibson

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“LUNCH WITH ZOIA”

Zoia was finishing her morning shift at the ref desk when the young man came up and said he couldn't find a book on the shelf. He wasn't wearing.

“Do you have the call number?” she asked. He held up his phone and showed the book in the catalogue: it was in the QCs, which were always hard to find. Her glasses recognized the small code on the page and popped up a small window to her left. The status showed it was on the shelf—at least, it wasn't checked out, hadn't been in seven months, and had been shelf-read three days ago when a wearing student assistant passed by.

“It should be there,” she said. “Come on, I'll help you find it.” If the student was wearing she'd have helped him install the library's app, because then he could have hit “Take me there” and it would have drawn arrows along the floor, up the stairs, and behind the offices, and then highlighted the section of the shelf where the book sat. Zoia herself didn't need that, of course, so she dismissed the window. They chatted as they went looking. He was in science studies. She could see from her calendar that there was a talk from a visiting prof in that area on Friday; he hadn't heard of it and was glad to know.

Back downstairs, two messages showed quietly: the second printer was out of paper, and George would be ten minutes late for lunch because the subways were still down from the storm two days earlier. She dismissed the printer warning—the students would see it—and sent a quick “no problem” to George. On the way out of the library, she saw the two student assistants, both wearing employee glasses: one was heading for the printer, and the other was charging out books by looking at student cards and the spines of the books.

Zoia was meeting George at a pub a ten-minute walk from her university that was also easy to get to from George’s public library, especially when the subways were working. She enjoyed the view as she left the university: she ran Adblock Lens, which she’d customized so it disabled every possible ad on campus as well as in the bus stops and on the billboards on the city streets. Sometimes she replaced them with live content, but today she just had the blanked spaces colored softly to blend in with what was around them. No ads, just a lot of beige and brown, slightly glitchy.

On top of that view she ran Architectivist, a new app that Ebscovier was beta testing. It overlaid information on buildings: identifying the address, it could search in city and other databases to find physical facts, ownership records, and tax values; image recognition was good at determining the architectural style; sometimes it would give biographies of the architect; and for well-known buildings, it could overlay the whole thing with 3-D photo-based recreations of how it looked over time. The Odeon was Zoia’s favorite—the marquee showed that Sinatra had performed in the early forties and Funkadelic in 1976. The app was good, but it cost too much and would be impossible to integrate with the university’s single sign-on system. She’d recommend against buying it. Anyway, only about 10 percent of the students wore. They could use the mobile version like everyone else for now. The whole thing grated on her nerves: almost all the data was from public sources, and they had to spend heavy annual fees to have it sold back to them.

Zoia cut down a shaded side street. She ran a new app built by students in a finance and environmental studies course: it showed a large 3-D model of the nearest best cheapest fast food. Two blocks ahead floated a large falafel. She looked behind her—there was a gyro a block back. This was a good app. It would get picked up by lots of people all over town, students and not, especially clubbers. She plussed the falafel because she knew the restaurant and liked it.

At the pub, the menu was enhanced, so they ordered through her glasses, and the waiter came by with their drinks a couple of minutes later and said the food would be ready soon. George shared a new app the public library had bought to

go with the materials it had for ambulance driver certification. Zoia's phone ran it once she decrypted access to her account, and they tried it while they waited. George couldn't afford glasses on a city salary, so he ran it on his phone. He threw a small marker on the table, a city popped up, and they each drove a little ambulance around, getting to emergencies quickly without many mistakes, but then they got bored and started running into cars and the app shut itself down and scolded them.

"Good thing we already have jobs," George said.

An hour later they had to get back to work. "I've got a thing, let me check . . ." Zoia said. She brought up her calendar to see if the consultation at 2:30 had supplied any details yet. The hour had turned red! "Uh-oh, it's that grad student I was telling you about. It'll be a long one. Well, see you Saturday."

She shut down everything except Adblock on the way back, walking slowly and enjoying the fall afternoon. When she entered the campus again, she brought up the work apps. Messages started fading in on the left, and to the right she could see the printer had jammed and the ref desk was unexpectedly busy and Robin needed backup. Back to work. At least she knew where to get a good gyro.

GETTING STARTED

Before we begin, if you haven't read *Rainbows End* by Vernor Vinge (Tor, 2006), then get your hands on a copy right now. It's mandatory reading for anyone interesting in augmented reality—especially in our field, because it describes the wildest book-digitization project ever. It's science fiction. These days we *live* in science fiction.

Now take out your smartphone and install and run Layar.¹ Tap the screen to make it scan this page. You'll see buttons and images floating a little above it. You can hear me say hello, see a picture of Saturn, read what @ala_lita has been tweeting recently, and more. I crammed a lot into a small space, but think what you could do like this with a handout, a poster, or even a wall in your library.

Next, install and run Junaio. Hold up your phone and look around. You'll probably see something like figure 3.1, with little icons floating in space. Your phone knows where you're standing and which direction you're pointing it, and Junaio uses that to find points of interest around you that are listed in Wikipedia with latitude and longitude. Press one to find out about it.

These are examples of augmented reality (AR): virtual objects added by computer to the real world around us.



FIGURE 3.1
Junaio View. North Along University Avenue
at College Street in Downtown Toronto

But actually that's not true: these aren't *really* augmented reality, the way AR will be. As first steps in AR, these apps and the others I'll cover are powerful. Compared to the AR we'll have by 2017, they're boring. It's difficult to talk about AR right now because things are changing very quickly. This is especially true with AR glasses. Some of the technology in this chapter will be out of date when you read it, but the general directions will, I hope, be relevant for a while.²

WHAT IS AUGMENTED REALITY?

Ronald Azuma's 1997 definition of AR is the simplest and clearest to me: "AR allows the user to see the real world, with virtual objects superimposed upon or composited with the real world. Therefore, AR supplements reality, rather than completely replacing it" (which virtual reality does). He set out three characteristics that a system must have to be augmented reality: "1) Combines real and virtual; 2) Interactive in real time; 3) Registered in 3-D" (that last meaning accurately placed in a 3D coordinate system: poor registration means virtual objects wiggle or jump around).³

There are other ways of thinking about AR. Milgram and Kishino set out "mixed reality" as a continuum spanning the completely real to the entirely virtual, with augmented reality closer to one end and augmented virtuality (virtual environments

including real objects) toward the other.⁴ Steve Mann, who has been wearing computer-enhanced eyewear for decades, is working on “augmediated reality,” which will let us “deliberately diminish, augment, and more generally re-map and modify reality perception”:⁵ we could subtract things from the real world that we don’t want to see (such as advertisements), or change things so we can see them better (such as adjusting the camera’s dynamic range so that something as bright as welding is as easy to see in clear detail). And Vinge is what really brings it all to life.⁶

A NOTE ABOUT PRIVACY

Using augmented reality involves sharing your location and using your camera to see what is around you. I won’t go into the privacy aspects, but keep it in mind as you read. If you wore AR glasses, how would you feel about your position and camera feed possibly being known to others? What do you think about being recorded as a background figure by the cameras other people are wearing? If your library has a policy about photography in the building now, how will you handle someone wearing AR glasses? Steve Mann’s idea of “sousveillance”⁷ is a good place to enter the debate on this issue, and Wikipedia has many links about it.

FOUR METHODS OF AUGMENTING REALITY

There are different ways of classifying types of AR, but for our purposes let’s say there are four: geolocation and markers are the main ways right now, but glasses and the physical environment are coming along very quickly. I’ll discuss each, with examples of and pointers on to how to start to make your own AR.

Geolocation

Geolocated AR is what you saw in Junaio (junaio.com). Smartphones know where you are, which direction you’re facing, and the angle you’re holding your phone. With that, an app can determine what should be added to the camera view to augment what is around you. There are problems, though: GPS isn’t exact, the registration is not fine enough, you may be identified only to within meters of where you are, things may jump around, and GPS doesn’t work inside buildings.

To see a geolocated view in Layar (layar.com), go into “Geo Layers” and search for “Tweeps Around” (for Twitter) or “Instagram” to see who has been posting to

these sites near you (and has been sharing their exact location). It's very interesting to be in a busy area when something is going on and to see how people all around you have been posting to social sites. Wikitude (wikitude.com) begins with a menu of different kinds of channels you can view, including nearby activity, Wikipedia entries, restaurants, transit, and more. As with Layar and Junaio, you can search or browse categories, but Wikitude does the best job of presenting the options attractively.

Worth noting is Mixare (mixare.org) because it is a free and open-source AR app (licensed under the GPL). By default it displays nearby points of interest from Wikipedia, Twitter, and OpenStreetMap, and other sources can be added. It does not seem to be under active development, but I hope that changes, because we very much need good open AR applications.

To make your own geolocated channels on these apps is free but takes some programming skills. You'll configure it on the vendor's website, then set up a web service under your control that takes in information such as latitude and longitude and returns points of interest (POIs) in the format the vendor wants (there is no standardization on this yet). They all have documentation on their websites and usually include many examples. The programming is not difficult, and if you have some geolocated data to experiment with, then I encourage you to try to get something working.⁸ (There is a third-party application called BuildAR (buildar.com) that gives you an easy interface to build and manage POIs for Junaio, for a monthly fee.)

A special note about Historypin (historypin.com), which is barely augmented reality but is a site all archives should know about.⁹ Users can upload photographs, video, audio, and text to the site and pin the media to a location and a time. It's most fun to work with photographs taken on streets, because Historypin has a tool that lets you use Google Street View to layer an old photograph on top of what the street looks like now. You can view these in a browser or on location with their app. My York University colleague Anna St.Onge pinned some historical photos of Toronto's Kensington Market, such as one of the Bellevue Nut Shop and Soda Bar in 1955.¹⁰ I went down there and overlaid the old photo on top of the camera view, and figure 3.2 is what I saw.

Historypin meets only one of Azuma's three criteria. And yet . . . it's a step along the path. Some day in the future you'll be able to walk down the street and see the past as it was, all around on all sides. But it will take a lot of work to get there: digitization, image analysis, registering the photos accurately stitching together multiple photos to make a 3-D view, and more.



FIGURE 3.2

1955 overlaid on top of 2013. It was difficult to line things up exactly because I was standing in the middle of a busy street.

Markers

Fiducial markers (the word derives from the Latin for “trust” or “confidence”) are objects predefined and ready for an AR application to recognize and use as a point of reference. Sometimes special markers are made that look like a cross between a QR code and a Jackson Pollock painting: they are visually rich, and not only can an application recognize them in any setting, it can also calculate the angle at which they are viewed. But any object can be turned into a marker: a page in a book (as with this chapter), a poster, a sign, or a product package. The application adds an augmentation on top of the marker and can allow you to see it from all sides, by moving the marker or yourself.

Layar, Junaio, and Wikitude all work with markers, often used for advertising. Look on their websites for examples (you can just scan a marker off your monitor to try it; you don’t need to print it out). There are a number of other basic apps available, the best being Augment (<http://augmentedev.com/>), which uses markers to show 3-D objects that can be moved, rotated, and resized. Something different is Word Lens (<http://questvisual.com/us/>), which translates words in real time as they appear in the camera view. Such functionality will probably become a part of all AR systems. An educational example is Daqri’s Anatomy 4D (www.daqri.com/project/anatomy-4d/), which uses a marker to anchor a 3-D human body and let



FIGURE 3.3

Layar Creator's drag-and-drop interface is easy to use.

the user look at bones, nerves, the circulatory or digestive systems, and more, from all angles.

Using markers to augment print is by far the easiest way to make your own AR. It's worth trying, and it takes only about half an hour to get something working. The three apps mentioned all have their own creation tools: Layar Creator (layar.com/creator/; see fig. 3.3) and Wikitude Studio (studio.wikitude.com) both work in the browser, and Junaio has desktop and smartphone applications. There are some differences between the systems, but generally they all allow you to augment an image with text, images, 3-D models, hyperlinks, video, audio, and live HTML. Pricing varies, and Layar lets you publish ad-supported pages for free.

Developing your own native application that uses image recognition for a custom 3-D AR experience requires a software development kit (SDK). The leading AR SDK is Qualcomm's Vuforia (<https://www.vuforia.com>), which integrates with the Unity 3D game engine (www.unity3d.com). Vuforia comes at no charge but is not free software and has a restrictive license. With it, you would be able to build an app that recognized markers and objects and added any augment you wanted on

top of them. You could also do this with OpenCV (www.opencv.org), the best free computer vision system, but it would take more work. Layar, Junaio, and Wikitude also have software development kits (SDKs) available for a fee or with restrictions.

Glasses

AR glasses seem to finally be ready to come onto the market for regular consumers. They combine very small cameras and displays: the mounted cameras recognize objects and hand gestures; a computer accurately locates these in space and calculates the augmentations to be added; then special displays in the glasses show the augments where the wearer's eyes see them and put everything all together into one. Glasses such as this can offer true augmented reality.

There are three systems worth following right now—though who knows how they will fare, and others will certainly come along. The first, Google Glass (www.google.com/glass/), isn't AR. When wearing Glass, you see a rectangle of content up and to the right in your field of vision: you can see a map, send a text, talk to someone through a video feed, and more. It's a remarkable piece of technology, but it's a hands-free phone, not AR. Yet.

The next two promise real AR. Unfortunately, neither is available as I write, but both should be out when this book is published. Vuzix (www.vuzix.com) has been working in the field for a while, but the M100 Smart Glasses are their first AR product aimed at regular folks. Meta, a startup with Steve Mann as its chief scientist, is making META.01 (www.spaceglasses.com; available September 2014). There are demo videos on both sites, and probably more will be there when you read this, so have a look for the most current information. If what Meta shows in their video actually works—two people playing chess on a virtual chessboard, for example, and someone designing an object in the air with an AR design program, then literally passing it over to a 3-D printer to become real—then it will be a huge step forward.

To develop apps for glasses, check the vendor websites for SDKs. Advanced programming skills are required. Eventually, I hope, there will be user-friendly tools that will let us manage AR environments in these systems—the equivalent of how easy WordPress and a few plugins make it to manage a website now.

Glasses will attract the most attention for AR and offer the most promise for what it can do. What glasses will be like in 2017 is impossible to predict, but until networked contact lenses are available that can show information right on your eye (which researchers are working on), glasses are where the most interesting and life-changing AR will happen.

The Physical Environment

A fourth way of doing AR is in the physical environment. Motion sensors can detect your movements in space and allow you to control virtual objects on a computer screen with gestures. If they show a camera view of you and what's around you, you can see yourself mixing the real and virtual on screen—perhaps grabbing and moving an object that seems to be floating in front of you. Motion detection can be combined with projectors showing things on surfaces around you; for example, displaying a keyboard you can type on and then dismiss.

Two new examples of such motion-detection systems are the Leap Motion (www.leapmotion.com), a small USB-connected device that can detect the positions of your hands and fingers with submillimeter accuracy; and Thalmic's Myo (www.thalmic.com/myo/), due in 2014, an armband that reads your muscle movements for computer control with gestures. Glasses also do gesture recognition, of course, but these devices may offer much better accuracy. And perhaps they will be combined: you could wear a Myo on your forearm to help control what you see through your glasses.

It's possible to use simple markers to do AR on screen with the physical environment right now. The ARToolKit (www.sourceforge.net/projects/artoolkit/) is a GPL system for doing this, and there are many variations online. Colleagues at York University built the SnapDragonAR system (www.futurestories.ca/snapdragon/) to make it easy to do AR this way. It was used to interesting effect by Geoffrey Alan Rhodes in his talk "AR on AR: Occupying Virtual Space."¹¹

CLOSED!

Practically everything I've mentioned so far is closed: closed-source and proprietary platforms. APIs (application programming interfaces) may be available but lock you in to one vendor's system. This makes it harder for libraries and archives to do AR. Today it means we need to do unnecessary work on duplicate platforms: presenting the same POIs on Layar and on Junaio means double work, for example. Picture what it will be like when we want to present an AR experience on two different kinds of glasses. Cross-platform development tools may be available, but they may cost a lot of money.

Library software vendors are notorious for charging for closed platforms today. Imagine if this gets worse. We need to use existing open standards and tools, support the development of necessary new ones, and make our content and source

code available under open licenses. If we can't write our own applications, then by making our content easily available we will encourage people to use it in their own—the same as happens now on the open Web.

AR IN USE

Other chapters about AR in this book discuss what's going inside libraries.¹² Here are three directions going out.

The Bavarian State Library (Bayerische Staatsbibliothek, or BSB) made an iOS app about Ludwig II of Bavaria, “Ludwig II—Walking the Footsteps of the Fairytale King,”¹³ that brings to life places and buildings in Munich and elsewhere that the mad king knew. It presents POIs near the user with supplementary information in text and multimedia, shows a 360-degree simulation of a building that no longer exists, and more. It's a wonderful example of a library pushing its material outside its walls and into the world where people can use it in place. (Inside the library they've done another interesting AR project, the 3D BSB Browser,¹⁴ which uses gesture control and eye tracking to give the user an interactive 3-D digitized historical book—without requiring any glasses. See Ceynowa¹⁵ for more about both.)

Special Collections Using Augmented Reality to Enhance Learning and Teaching, or SCARLET (teamscarlet.wordpress.com), is a project of several UK universities that is interesting for what it has done and also how it has been organized. The website explains,

SCARLET addresses one of the principal obstacles to the use of Special Collections in teaching and learning—the fact that students must consult rare books, manuscripts and archives within the controlled conditions of library study rooms. The material is isolated from the secondary, supporting materials and the growing mass of related digital assets. This is an alien experience for students familiar with an information-rich, connected wireless world, and is a barrier to their use of Special Collections.¹⁶

In one project they used Junaio to make a channel to open up part of a large collection of social research. The website documents their work in detail.

To consider what archives might do with AR, it's worthwhile to look at what museums have done, since they generally have more money and more visitors.¹⁷

The Museum of London's "Street Museum" app¹⁸ highlights historical photos from their collection similar to Historypin. The Asian Art Museum in San Francisco had an iOS app¹⁹ made for its *China's Terracotta Warriors* exhibit in early 2013; the main feature is that you can see an "animated life-sized 3D terracotta warrior." Most notably the British Museum has done several Junaio-based AR projects aimed at children, and Shelley Mannion's 2012 talk "Beyond Cool: Making Mobile Augmented Reality Work for Museum Education" gives a good overview of them, including lessons learned. The augmented camera view was especially exciting for users, she says: "The biggest surprise with the AR activity was students' utter fascination with the live camera view. It was so entrancing that, from the moment the AR module went live halfway through the project, camera usage [for taking photos] on the phones dropped dramatically."²⁰

TEN IMPLICATIONS FOR THE FUTURE

It's a mug's game to predict how augmented reality will go over the next three or four years, but here are some things we can do that will serve us well no matter how things end. I think AR will grow enormously, and if it does, these approaches will help. If it doesn't, we will have learned something, and we'll still be ready for whatever comes next.

1. Augmented reality glasses are where things will happen. When you can, get your hands on a pair and try them. It will be a worthwhile investment.
2. We must provide content in standard ways. APIs should be open and clearly documented. If content is available for use in platform A, it should be easily reused for platform B. Assume that whatever we're making will be out of date in a year or two and that we'll need to rewrite it or move it to a new platform. Building with standards and open code will make this easier; providing content for reuse by others under open licenses will too.
3. Archives and special collections are probably the best units to start trying out AR because they have unique content that can be brought to life in new ways, so have these staff do the pilot projects. These colleagues will have useful examples to show others who can apply

AR elsewhere. This experimentation might take place with basic things such as signs and handouts first, but how will AR be used in information literacy and in the research process? The IL librarians need to be thinking about this.

4. We need to put pressure on vendors to keep our needs in mind. They will eventually start to make AR apps—probably first in STEM and medicine—but such apps will be even less usable and harder to integrate into our systems than their mobile applications are now. And they will cost a lot. Ownership and licensing will be confused.
5. The technical skills required to do advanced AR are high, but basic AR today is very approachable and a good learning experience. Anyone interested should experiment with it. Building IT skills in libraries is a hard problem, and it's not going to get any easier. Be prepared to spend more time and money. This problem is not going to get any simpler.
6. We will grow with partners: community groups with their own special content; students and professors learning and teaching in new ways; local makerspaces with skills and tools. We have special knowledge, collections, and expertise that others will be interested in, and libraries are friendly, safe places to work together. We should get involved wherever AR is being worked on in our communities. Go to meetups. We can't make it all ourselves, and there are smart people out there.
7. Accessibility programs and policies will need to adapt.
8. Privacy and legal implications will be ever more important.
9. The divide will grow between those with the right hardware who can run the latest apps and those without who can't. We still need to provide full access to all resources to everyone. Some of your users will have the latest fancy glasses; others won't have Internet access at home. Academic librarians: can you lend out AR glasses on reserve when an instructor assigns an AR app for a class?
10. Though AR may not make huge changes quickly to what happens inside libraries or how people read or do research, we need to fit in with how the rest of world is going. Smartphones and social media may be a useful parallel: the core purposes of libraries are still the same as before Facebook and Twitter, but we are adapting to fit in to a much-changed information landscape. We will need to do the same with AR, whatever that turns out to be.

MORE INFORMATION

Everything about AR is changing quickly, and this chapter will be out of date when you read it. To help fight this, I will maintain a web page at www.miskatonic.org/ar/ that has links to everything mentioned in this chapter and to other AR resources of interest to librarians and archivists, including blogs and Twitter accounts. Right now Twitter is the best way to keep up with what's happening (my list of AR-related accounts at twitter.com/wdenton/ar is a good place to start.)

AR conferences are good sources to see who is talking about what, whether it's researchers or vendors, theory or applications. The major academic conference is the IEEE International Symposium on Mixed and Augmented Reality (ISMAR, www.ismar.net), but others, such as the IEEE Society on the Social Implications of Technology's (www.ieeessit.org) ISTAS (International Symposium on Technology and Society), are important. Practitioners go to the academic conferences, but more specifically there is the Augmented World Expo (augmentedworldexpo.com), which calls itself "the world's largest augmented reality trade show"; the Augmented Reality Summit (augmentedrealitysummit.com); and Metaio's insideAR (www.metaio.com/insidear/home/).

Standards are important. Libraries and archives have lots of our own standards that need to be integrated with the AR world, and AR needs its own standards, such as ARML from the Open Geospatial Consortium (opengeospatial.org). The grassroots group ARStandards (www.perey.com/ARStandards/) is working on this. For more about this and other discussion, see also the W3C Augmented Reality Community Group (www.w3.org/community/ar/).

NOTES

1. You may not have a smartphone, or it may not be able to run Layar or Junaio. If this happens to you reading this book, imagine the problems ahead for our users.
2. To keep up to date with current information, see my supporting web page at www.miskatonic.org/ar/lita. In print, see Gregory Kipper and Joseph Rampolla, *Augmented Reality: An Emerging Technologies Guide to AR*, Waltham, MA: Syngress, 2012. Kipper and Rampolla's work is a thorough overview of where AR was at, but it's already out of date as I write a few months after it was published.
3. Ronald T Azuma, "A Survey of Augmented Reality," *Presence: Teleoperators and Virtual Environments* 6, no. 4 (August 1997): 2, www.ronaldazuma.com/papers/ARpresence.pdf.
4. Paul Milgram and Fumio Kishino, "A Taxonomy of Mixed Reality Visual Displays." *IEICE Transactions on Information Systems* E77-D, no. 12 (December 1994), http://etclab.mie.utoronto.ca/people/paul_dir/IEICE94/ieice.html.

5. Steve Mann, "Augmediated Reality and 'McVeillance,'" *Steve Mann's Blog*. September 13, 2012, <http://eyetap.blogspot.ca/2012/09/augmediated-reality-and-mcveillance.html>. See also Steve Mann, "My 'Augmediated' Life: What I've Learned from 35 Years of Wearing Computerized Eyewear." *IEEE Spectrum*, March 1, 2013, <http://spectrum.ieee.org/geek-life/profiles/steve-mann-my-augmediated-life>.
6. Vernor Vinge, *Rainbows End* (New York: Tor, 2006).
7. Steve Mann, "Veillance and Reciprocal Transparency: Surveillance versus Sousveillance, AR Glass, Lifelogging, and Wearable Computing," paper presented at IEEE International Symposium on Technology and Society (ISTAS) 2013 conference, June 2013, <http://wearcam.org/veillance/veillance.pdf>.
8. I myself wrote *Avoirdupois* (github.com/wdenton/avoirdupois), a simple Ruby web service that drives Layar POIs, and *Laertes* (github.com/wdenton/avoirdupois), which brings together nearby tweets and points of interest from a Google Map.
9. There is a page for libraries, archives and museums at historypin.com/community/lams/.
10. See www.historypin.com/channels/view/id/5604123/#|map/index/#!/geo:43.657111,-79.404512/zoom:20/dialog:16591017/tab:details.
11. See <https://www.youtube.com/watch?v=SyAkUJCgDUk>.
12. See also Jim Hahn, 2012, "Mobile Augmented Reality Applications for Library Services," *New Library World* 113 (9/10): 429–438, doi:10.1108/03074801211273902.
13. See www.bayerische-landesbibliothek-online.de/ludwigii-appeng.
14. See Bayerische Staatsbibliothek's October 2012 YouTube video, "Der 3D-BSB-Explorer —Handschriften lesen in 3D," <https://www.youtube.com/watch?v=eyPRjMerCkU>. www.bsb-muenchen.de/News.3782+M5de7ca0470e.0.html.
15. Klaus Ceynowa, "Augmented Reality, Location Based Services and More: Innovative User Scenarios for Library Content," February 2013, <https://www.youtube.com/watch?v=gp9tAzTLUXU>.
16. "About the Project," SCARLET (Special Collections Using Augmented Reality to Enhance Learning and Teaching), accessed August 15, 2012, <http://teamsscarlet.wordpress.com/about>.
17. You can see a lot with a YouTube or Vimeo search for "augmented reality museum"—video always helps make the experience more understandable.
18. See www.museumoflondon.org.uk/Resources/app/you-are-here-app/home.html.
19. See www.magma-studios.com/ar/aam.
20. Shelley Mannion, "Beyond Cool: Making Mobile Augmented Reality Work for Museum Education," April 2012, www.museumsandtheweb.com/mw2012/papers/beyond_cool_making_mobile_augmented_reality_wo.