Transporting and Preserving Interactive New Media Exhibits Through Time

by Bill Meyer

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The preservation of interactive new media exhibits relies on proactive decisions about how to keep unique and custom software running indefinitely even as associated computer hardware becomes predictably obsolete.

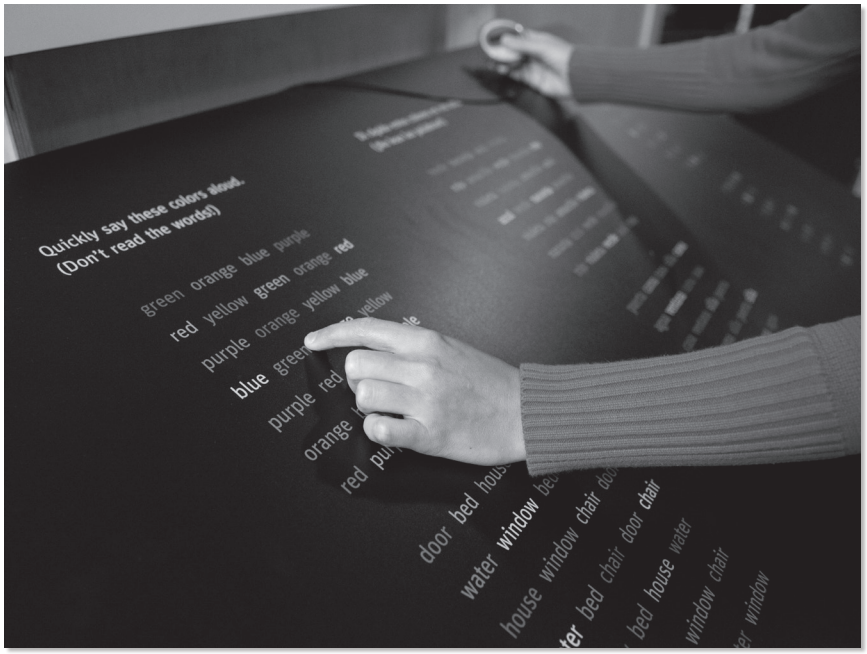
As digital technologies advance, museums are increasingly likely to display interactive exhibits employing new media. At their heart these pieces involve software—embodying codified human thought and creativity—focused on choreographing actual human experiences. Exhibits may involve physical computing, gestural or tangible user interfaces (sensing and responding to visitors without keyboard, mouse, or display) or leverage cloud-based components where code exists in an ether of remote Internet-linked devices and services. Always, one or more computers exist somewhere to run the software powering an exhibit. These computers—on a chip, in a box, or at the end of distant wires—are vital yet changeable vehicles. Examining three recently refurbished Exploratorium exhibits as case studies, this article explores how to approach new media exhibit preservation, providing links to related resources and a checklist of helpful questions to ask.

Some new media experiences feel timeless, remaining strong and relevant as technology progresses. Others seem more ephemeral, bound to particular cultural or technological moments. The latter are important to document and preserve as cultural artifacts, but may not always age well as visitor experiences. Even new media exhibits illustrating enduring, robust phenomena present challenges as museums move them forward through years or decades. The preservation of interactive new media exhibits relies on proactive decisions about how to keep unique and custom software running indefinitely even as associated computer hardware becomes predictably obsolete, generally in three-to-five-year life-cycles (Garretson, 2010). Ultimately, computers and operating systems become classified as "unsupported," i.e. vendors cease to offer technical support, release updates, or manufacture replacement parts.

Context and Basic Terminology

Updating very old software can mean complicated and expensive reprogramming, but more proactive attention may only involve smaller "code updates," enabling exhibits to be transported gracefully from one operating system or hardware/software platform to the next. "Porting" is shorthand for this process; "platform" may refer to a type of computer, an operating system, a programming language, or a combination of these. There are many examples: Macintosh, Windows, Unix, or Android; Director, Flash or HTML5; cloud-based platforms like Amazon Web Service or Google Apps Engine; or "embedded systems" that include exhibit-friendly single-board computers such as the Raspberry Pi (Glass, 2013) or Arduino microcontroller (Long, 2012).

Many Exploratorium exhibits offer useful examples of this preservation process. Due to the forethought that goes into their design and the rigorous evaluation they undergo as they're developed, they tend to age well as interactive experiences. Exhibits engage visitors with phenomena or data observable in the physical world, other living organisms, or in one's own body, mind, and social behaviors. When the Exploratorium moved to Pier 15 on the San Francisco waterfront in 2013, 150 new exhibits were developed—but 450 existing exhibits were refurbished. This presented an opportunity to move new media preservation from theory



Color Conflicts *exhibit engages a visitor at the Exploratorium. Photo by Amy Snyder.*

into practice. Here, we'll examine three exhibit refurbishments exemplifying varying levels of technical complexity and correspondingly different approaches.

Color Conflicts: Is New Media Required?

In this exhibit, visitors see words naming colors, where each word is printed in a completely different color from that which it describes; e.g. "yellow" is written in blue letters. Visitors must speak aloud the actual colors they see words printed in, not colors those words name. Because reading words in a language one understands is ingrained and automatic, people find performing this exhibit task is slower than expected and fraught with mistakes. The "aha moment" comes when visitors discover that speaking colors of words printed in languages they *don't* understand (e.g., Chinese words for English-speaking readers) goes much faster, because no verbal-visual conflict exists. Called the Stroop Effect, and widely used in psychological research, this phenomenon remains as strong and surprising today as in 1935 when J.R. Stroop first published on it.

The Exploratorium developed a version of our exhibit for the Children's Library Discovery Center at the Queens Library in New York. Approximately 179 languages are spoken in Queens; we included seven in the touchscreen-based exhibit created for the Center. In this version, visitors select a language, and the exhibit automatically times their progress. However, the core experience *doesn't require new media*. The exhibit was originally developed as a three-language printed graphic panel with a tethered stopwatch, and it remains so today at the Exploratorium, where we consciously elected to keep technology to a minimum for this experience. In the Queens version, where books and posters abound and so many languages are spoken, the colorful touchscreen exhibit is purposefully novel. It cycles through all seven languages, some with strikingly beautiful characters, attracting more young visitors there than static graphics likely could. At the Exploratorium, where tangible exhibits and kiosks are more ubiquitous than printed words, a large colorful stationary graphic easily commands attention. In each case, choice of media was informed by carefully assessing not just the phenomenon of the exhibit but the context in which it would live.

Listening While Talking: Desktop Computer to Embedded System

In 2004, I attended a lecture at which Steve Seidel spoke about Harvard's Project Zero and "creating museums of learning." He commented that "one of the greatest obstacles to children's learning is they don't understand they can't listen while talking." I wondered if technology could empower visitors to explore this phenomenon in a museum context. Ultimately, I created a kiosk with a telephone handset where visitors pick up the phone to both hear jokes and enable an unseen computer to detect when they're speaking. The catch: people hear jokes

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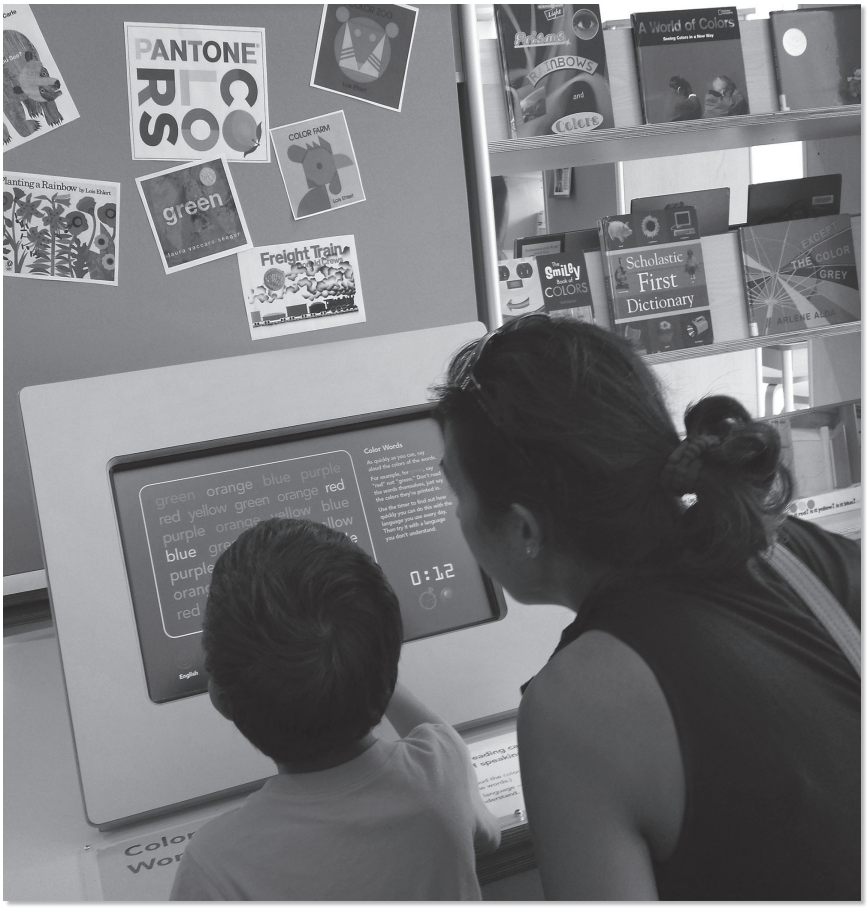

Parent and child experiment together with Color Words *at the Queens Children's Library Discovery Center. Photo by Lynn Cole. Courtesy of Queens Library.*

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only *while* speaking; when they pause, the jokes pause too. Even when just describing the shoes on their feet, visitors of all ages find it incredibly difficult to make sense of simple jokes, discovering what scientists call *articulatory suppression in the brain's phonological loop* (Goldstein, 2008).

Prototyping this exhibit, I experimented with many microphone/speaker arrangements and content types, using a desktop computer and full-featured media development software (then Adobe Director) enabling me to rapidly test multiple iterations with visitors. The experience was methodically shaped into something strong and clear. As is often the case for one-off interactives created by museums, artists, and exhibition design firms, the resulting exhibit employed the same technology used to develop the prototype. Updating the exhibit in 2013, we could have installed a newer PC and ported software to Flash, Processing or HTML5—all current and supported. However, since the visitor interaction was well defined and proven, an option requiring far less upkeep was possible.

As with other exhibits of comparable complexity, we eliminated the costly high-maintenance desktop computer by porting the exhibit's software onto an inexpensive and virtually maintenance-free Arduino microcontroller. Importantly, the difference is completely irrelevant to the visitor experience, which remained identical. Arduinos are ideal where no monitors or projectors are involved. When graphics or more software complexity is required, a more suitable option may be the Raspberry Pi, a $35 single-board (Linux/Debian) computer that does much that desktop PCs can do, including running fairly complex software, playing videos, and displaying dynamic text in varieties of fonts and sizes. Instead of hard drives, these tiny computers use the same type of SD cards utilized by digital cameras to store software and media

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assets. Just a few inches in size, these devices tuck easily into kiosks with no cooling fans required and little hardware to fail. Pre-programmed spares should survive for decades and can be quickly swapped-in if hardware does get damaged.

In a parallel effort, the Exploratorium Online Engagement team developed the *Sound Uncovered* iPad App (downloadable for free at Apple's iTunes App store) containing a collection of experiential interactive exhibits. As part of this App, *Listening While Talking* was incorporated and renamed *Stop Me if You've Heard This One*. For suitable exhibits, multi-platform preservation options may be possible—including the creation of virtual versions that complement or extend in-person experiences.

Microscope Imaging Station: A Move to Open Source

With three visitor kiosks, research-grade microscopes, networked video cameras and many software programs working in concert, the Microscope Imaging Station is actually a suite of exhibits. Visitors control microscopes as interactive kiosks guide them through specimen positioning, focus, choice of magnification and lighting filter. Complicated back-end software translates visitor selections and joystick movements into precise microscope control within safe operating limits. The thought of refurbishing this complex multi-visitor experience struck fear into the hearts of those charged with the task.

The Station's interactive media components were relatively easily ported to new computers, but back-end control software was another matter. An older

Exploratorium's refurbished Listening While Talking *exhibit. A high-maintenance desktop computer (upper left) was replaced by a compact, low-maintenance, solid-state Arduino microcontroller (upper right). Photos by Gayle Laird and Sue Pomon.*

Visitors investigating live specimens at the Microscope Imaging Station *at the Exploratorium's new Embarcadero location. Photo by Amy Snyder.*

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Leveraging well-supported open source technologies can help even highly complicated exhibits move forward through time more easily and cost-effectively.

programming language version and associated Windows operating system was no longer supported, meaning extensive re-writing was required. When we initially developed the Station, creating and refining this control software took several years. Before refurbishing, we sought advice from microscope vendors and colleagues at research labs familiar with not just our microscope models, but also the field's technology in general. This led us to an open source project called *μManager* (Micro Manager) specializing in software control of research microscopes. This free and powerful software is continually updated by a savvy user/developer community and supports a wide variety of microscopes used in research labs around the world, including associated cameras and many fancy gadgets.

It turned out the *μManager* project originated locally at the University of California San Francisco, and their team loved the idea of the Exploratorium utilizing the software for a hands-on microscopy exhibit. A programmer from the project was contracted to assist. The software proved easy to install onto new computers, connect to our microscopes, and integrate with our interactive kiosk programs. In addition to updating the Station, we became part of a vibrant user community, and opportunities opened for new types of collaborations with colleagues in the life sciences research community. Initial R & D done thirteen years earlier, which resulted in a robust and meaningful visitor experience of microscope control and specimen investigation, is poised for a new life: connecting labs, classrooms and museums—even extending onto tablets and mobile devices. Leveraging well-supported open source technologies can help even highly complicated exhibits move forward through time more easily and cost-effectively.

Interactive New Media Exhibit Preservation Checklist

A guide for conversations with media artists, exhibit developers and technologists:

1. Is new media required for the experience and context? If not, consider lower-tech alternatives.

2. What can be known about general visitor interest, knowledge of a topic, and behavior from previous installations to inform a new iteration?

3. Could the exhibit work as an App or on the web? Are there unique benefits to a physical installation?

4. Artist pieces and collaborations pose special challenges around maintaining fidelity to the original work as time passes. Formalize

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agreements to prevent future complications, such as:
   a. staying true to artists' or designers' visions vs. educators' intended learning outcomes;
   b. defining the visitor experience in enough specificity for the museum to update software and hardware on its own;
   c. determining which components require historical preservation and which can be updated for easier maintenance.

5. Are buttons, touchscreen/table/wall, proximity sensing, speech detection, etc., of robust public kiosk quality?

6. Does the piece accumulate data or "evolve" such that backups are necessary to insure continued integrity? Are backups intermittently tested?

7. Is exhibit software current with versions of its associated platform (Flash, Max/MSP/Jitter, OpenFrameworks, etc.)? Ideally, a large developer community uses and supports the platform you are considering.

8. For desktop computers:
   a. can the piece run on current hardware and operating systems?
   b. would visitors perceive a difference if a much lower-maintenance microcontroller or embedded system (Arduino, Raspberry Pi) replaced the desktop?

9. Does the piece require network connectivity to other devices in the museum or outside world? Do outside people or things *initiate* communication to the piece via the Internet? If the latter, IT likely needs to support a non-standard network connection involving special firewall modifications.

10. How complex is the technology? Does in-house staff have the expertise to maintain it? Can assistance be accessed in timely and cost-effective ways? Is a "service level agreement" (SLA) clear for such support?

Conclusion

When acquiring or creating new media pieces, assume future upgrades will be necessary, involving hardware and software platforms that can't—and perhaps shouldn't be specifically predicted. Finesse may be required in helping involved parties remain focused on defining and preserving the core *experiences* you're after, while reducing attachments to the transitory *stuff* enabling them. Evaluating complexity, examining history of exhibits at similar levels, factoring in technological trends, and establishing where software/hardware components are in their life cycles will inform accurate preservation cost budgeting.

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Garretson, C. (2010, April 22). Pulling the plug on old hardware: Life-cycle management explained. *Computerworld*. Retrieved June 05, 2013, from www.computerworld.com

Glass, N. (2013, January 08). Why everybody wants a slice of Raspberry Pi. Retrieved on June 14, 2013, from CNN.com

Long, T. C. (2012). Hackerspaces, fab labs, and the democratization of exhibits. *Exhibitionist*, 31(2), 40–44.

Goldstein, E. B. (2008). Short-term and working memory. In *Cognitive psychology: Connecting mind, research, and everyday experience* (pp. 158–159). Australia: Thomson Wadsworth.

Additional Resources:
Documenting Media Art
www.guggenheim.org/new-york/collections/conservation/time-based-media/media-art-documentation

Digital Art Conservation Project
www02.zkm.de/digitalartconservation

Forging the Future
forging-the-future.net

Matters in Media Art
tate.org.uk/about/projects/matters-media-art

Emerging Technologies Impacting Museums
nmc.org/horizon-project/horizon-reports/horizon-report-museum-edition

The Variable Media Network
variablemedia.net