Designing Intergenerational Mobile Storytelling

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ABSTRACT
Informal educational experiences with grandparents and other older adults can be an important component of children's education, especially in circumstances where high quality educational services and facilities are not readily available. Mobile devices offer unique capabilities to support such interactions. We report on an ongoing participatory design project with an intergenerational design group to create mobile applications for reading and editing books, or even creating all new stories on an Apple iPhone.

AUTHOR KEYWORDS
Intergenerational design, mobile reading, digital libraries, storytelling, participatory design, children, design, mobile user interfaces, iPhone.

ACM CLASSIFICATION KEYWORDS
H.5.2. User Interfaces: User-centered design, prototyping

THE NEED FOR RESEARCH
From the Middle East to northern Africa, to right here in the United States, the world's children are growing up impacted by conflict, poverty, and lack of school resources [1, 4, 12]. The 20th century model of shipping books and other educational materials to various parts of the world is increasingly difficult and expensive. Complicating these challenges, parents and other family members are lost to war, famine, and diseases (in particular HIV/AIDS), which leaves children with little understanding of their own cultures and personal family histories [2, 20]. The need has never been greater to educate the world's children.

As mobile technologies become ubiquitous (through the growth of netbooks and common mobile phone technologies), this "21st century computing platform" has emerged as one way to address the many challenges of educating young people even in developing countries [1, 18]. *Anytime, anywhere computing*, can lead to affordable and portable paths to information access and learning. Therefore we have been adapting and enhancing the technologies of digital books, multi-sensory story creation, and distributed storytelling for the mobile platform to be used by disadvantaged learners at the extremes of life (older adults and children).

From data collection by children for field research [5, 15, 17, 19], to accessing information via text or voice [8], to use as mobile guides [6, 10], mobile devices in recent years have begun supporting learning from science to social studies. However, little research has been done to date with mobile technologies to support children in developing multiple forms of literacy through children's literature and storytelling. This is evidenced by the few articles that have been published in scholarly journals.

It has been found in many struggling economies that access to educational services and materials has actually declined in recent years [1, 8]. This coupled with the lack of success for many children in traditional school settings, seems to suggest that a different approach to education is needed. Studies have shown that interactions between older and younger people, can improve children's motivation for learning, and increase their awareness of personal and community culture [8, 13]. Yet, little discussion in the research literature on mobile computing focuses on

Figure 1. Today's *ICDL for iPhone* application displays children's books that can be read on an Apple iPhone. (a) Four books to choose from. (b) An overview of the Arabic/English book, *Black Ear… Blond Ear*.

intergenerational learning experiences — where grandparents, "grandfriends," and/or community elders can have a role in educating the next generation of children.

Therefore, we have been exploring how informal educational experiences with older adults can enhance the literacy development experience for disadvantaged children. Among the challenges of this work have been the development of interfaces that are usable by older users and the young users alike while enabling the two to smoothly collaborate. Much of the literature has shown that interfaces for children and older adults may not be the same or even compatible.

MOBILE INTERFACE TECHNOLOGIES

To make this vision a reality, a team of researchers, including the founders of the International Children's Digital Library (ICDL), are leveraging their expertise in interaction, technology for children, and mobile user interface design to adapt existing ICDL content and infrastructure for mobile technologies. Currently, the ICDL (freely available at www.childrenslibrary.org) is used on the Internet by over 100,000 unique visitors per month from around the world. The library's use is split between children, parents, teachers and librarians as determined by surveys and optional account logon information. At present, books from 60 countries are available in the ICDL via a web interface that includes multiple visual querying tools for selecting books, and three interaction styles for reading books online. The ICDL is a stable and robust platform served from Linux machines at the University of Maryland running custom application code built with Java, MySQL and Lucene, and served by Apache and Tomcat.

We are currently working toward delivering some of the ICDL books on Apple's iPhone with support for text and images to be read aloud by children and their trusted adults (such as a grand parents). To do this, we need access to the book's text, scaled imagery of the book *without* the text, and indexed recorded audio of the text. Our recent work with ICDL to increase readability and accessibility [16] solves the first two problems by using image processing to locate and remove the text from the page scans, and then store many sizes of those images on our servers. We created an initial iPhone version [3], which can be seen in Figures 1 and 2.

We are currently developing recording capacity and acquiring rights to contemporary books to record them ourselves. If more ICDL content were available in audio form, it would give us more flexibility for mobile application design because readability of text on the small screen could be less of an issue.

INTERGENERATIONAL DESIGN

Seventy-three-year-old Myles and nine-year-old Dana are sitting on our couch reading the Arabic/English book, *Black Ear… Blond Ear*, by Khaled Jumm'a. It is a book about two groups of cats, the light-colored cats and the black cats,

Figure 2. Reading a book in the *ICDL for iPhone* application. (a) An example of one page of the book. and (b) The same page with the English text magnified.

who learn to make peace by listening to each other by actually exchanging their ears. The book has been digitized and is available on a mobile phone. Myles is reading the story to Dana, periodically suggesting that she read a page to him. He helps as Dana stumbles on a word or pronounces a word incorrectly. As they are reading, they are also helping to design a new mobile intergenerational reading application. Dana suggests to Myles, "There should be a READ ME button, so if you're not here, I can hear you reading the story with me."

Myles adds, "Yeah, but I think you should read the book to me with that button. You've got better eyes to look at that small screen than me."

One of the lab's staff asks, "What if we highlighted the words here? Would you notice them enough to talk about them?"

Myles says, "Sure, if they're BIG! Let's see, what part are you talking about … ?"

Thanks to this design session with Myles and Dana, along with three other child/grandparent reading pairs, people can now read children's books from such places as New Zealand, Egypt, and the United States on their iPhones. We are now actively developing the story-creation application. Currently, development on the reading application is complete, while development is ongoing on a second application for creating and/or editing books.

4. APPLICATION DEVELOPMENT

For development and experimental purposes, we are working with the iPhone and iPod Touch platforms. The latter are less expensive, but lack a camera and readily

usable audio facilities, but are otherwise suitable and economically feasible for this research. Both the iPhone and iPod Touch offer relatively large displays (4.5 inches × 2.4 inches, 115 mm × 61 mm, 320×480 pixels). Furthermore, both devices have a high quality capacitive multi-touch touch screen, and built-in graphics processing unit (GPU), making it possible to create rich, visual interfaces such as zooming or touch-based manipulation.

Reading

Using the book reading application we are developing (Figures 1 and 2), families can comfortably read children's books on the device, allowing opportunities for reading together in almost any setting. For the first version, the application is limited to only four books, the content of which is included in the application. Thus, once the application has been downloaded, no further Internet access is necessary; books can be read even in a subway tunnel. The application is currently available by searching for "ICDL" in Apple's App Store or through Apple iTunes.

The application uses the unique capabilities of the device to provide a rich experience. Rotating the device switches between landscape (2-page) and portrait (1-page) views. Tapping on the cover of a book zooms in to view the thumbnails of the book pages. Tapping on a book page zooms in to view that page. Swiping a finger across the touch screen advances to the next or previous page. When text is too small to be read comfortably, tapping on the text causes it to pop out and be displayed in a larger font size, but still in the context of the illustrations (Figure 2).

Participants in our intergenerational design group have helped to refine the design. They have suggested possible ways to scroll text or transition between pages. In working with the full team of children with grandparents, we were surprised that among about eight children and seven grandparents, there were no significant problems with access to the device; the pairs were able to easily negotiate who would hold and manipulate the device at a given time, with both the child and the grandparent sharing control. Furthermore, all of the elderly participants said they could read the text comfortably. We could see them reading the text with the children so this is believable.

Editing Books

The next step was to build an application capable of editing books. As a first step, we enable children and their families to make changes to the content of the books. The current interface allows them to use touch-based painting to modify the illustrations and use the device's onscreen keyboard to modify the text. Text boxes can be moved, resized, added, and deleted. In this way, the interface is similar to a simplified, touch-based analog of many object-based drawing programs (i.e., Microsoft PowerPoint). However, the editing application also allows users to take pictures using the iPhone's camera or insert items stored in the built-in photo album available on both devices. Those photos may have been copied from a personal computer or saved from web pages while browsing on the mobile device. The editing interface is shown in Figure 3.

We have been working with children in the lab to iterate on designs, suggest new design directions, and to give feedback on prototypes. The tone of the sessions has been marked by excitement and cooperation, largely because the children have been enthusiastic about using the devices to create stories and share them with others. The children were so deeply immersed in creating their own stories with the application that when implementation bugs in the prototypes were discovered, they complained passionately.

We quickly discovered the importance of sound for "read-aloud." We have also seen the participants being deeply engaged while annotating photos with voice. In addition, the need to project or show the story on a larger screen has come up numerous times in our design experiences.

FUTURE WORK

As development of the story editor application nears completion, we are planning a formal evaluation of this work to be conducted during summer 2009. We anticipate

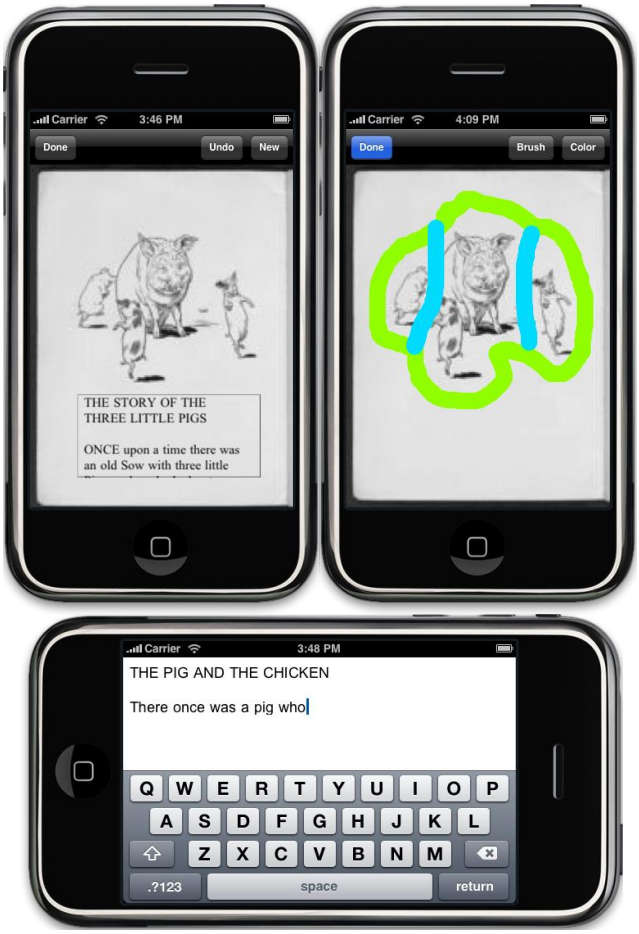

Figure 3. Editing the book, *The Three Little Pigs.* (a) Original book page. (b) Altering the illustration. (c) Changing the text.

using a variety of research methods to understand changes in children and older adults: interviews, web logs, and artifact analysis. We will also ask the elders to journal using voice logs in support of the reflection process.

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